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Melting Iron in a British Shop

Improved Methods Adopted by North of England Rail-chair Foundry Have Increased Output 12 Per Cent and Reduced Labor Costs $1800 a Year—Charges Weighed Accurately

BY H. COLE ESTEP

European Manager, The Foundry

MANY years research into the factors governing the operation of both cupolas and blast furnaces have shown that uniformity of charging and regularity of operation are fundamental to success. Conversely, constant fluctuations in burden, irregularities in the quality and quantity of fuel, changes in blast pressure and volume, and other variations from standard practice, are responsible for a majority of foundrymen's melting troubles. Uniformity of operation, when dealing with the cupola, is easy to talk about and difficult to realize under ordinary shop conditions. One reason why blast furnace managers have been successful in this direction lies in the fact that the modern blast furnace stack is charged by machinery, whereas the average foundry cupola is burdened by hand. Mechanical charging means regular charging; filling the cupola by hand means that human vagaries have free scope. In blast-furnace operation the human element has not only been reduced to a minimum but that which remains is rigorously controlled. The work of the furnace gang is constantly under the watchful eyes of high priced experts, who are on the job night and day. Cupola charging is too frequently left to the discretion of Mike, Steve, and Angelo, who do their work in the easiest way, which is far from being the best way, as Pat Dwyer succintly pointed out in the May 1 issue of THE FOUNDRY in Bill's comments on cupola practice.

"The tendency of cupola hands to dump whatever they have on their barrows into the furnace, whether it is over or under weight, unless they are constantly watched, is universal," said R. O. Patterson, manager of Smith-Patterson & Co. Ltd., Blayden-on-Tyne, England, recently, "and in this respect British foundrymen aren't any different than their confreres in other parts of the world. Mr. Dwyer in his recent article," continued Mr. Patterson, "hit upon an extremely important element in cupola operation. It was a consideration of these very same factors several months ago that led us to provide a new cupola-charging plant for our rail-chair foundry. This plant, which was designed and built entirely by ourselves, has now been in operation a short time and has fully justified its cost, including two new cupolas of about £4000. Having frequently noted, as Mr. Dwyer points out, that our

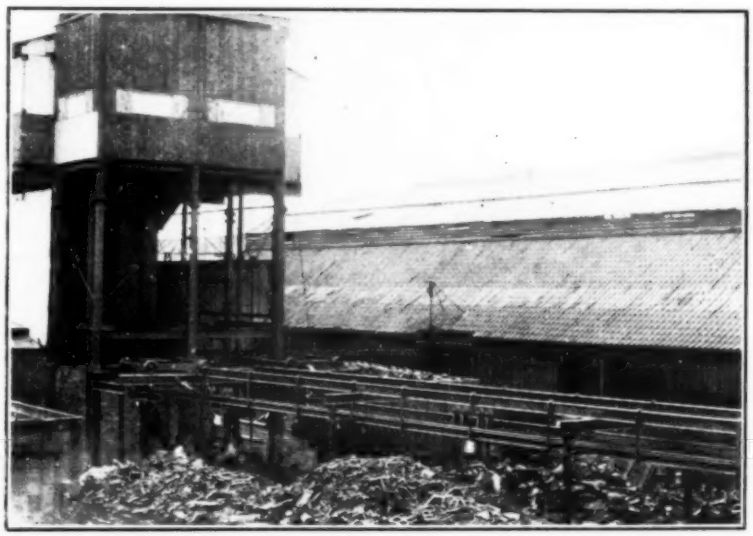

FIG. 1—STOCKYARD SHOWING ARRANGEMENT OF MONORAILS

men when left to themselves seldom really weighed their charges properly, we determined to eliminate this difficulty among others in our new layout. We felt that an improvement in regularity of charging would alone justify an investment in special equipment, particularly in view of the fact that our rail-chair foundry operates continuously and casts over 80 tons a day. But I have always believed that the best way to cure men of bad shop habits is not by constant nagging and reproof, but by making it easier to do things the right way than the wrong way. In other words, if you can make the right way to do a thing also the easiest way, then you can rest assured the work will be done properly even if the foreman is home with a toothache."

How Mr. Patterson and his associates reached this objective in their cupola practice, it is the purpose of this article to describe. The methods of charging adopted have resulted in increasing the melt of the Smith-Patterson & Co. cupolas by about 12 per cent at the same time reducing the labor charges by $35 a week and giving a hotter metal of more uniform quality with slightly improved coke consumption. This is on an output of 400 to 450 gross tons a week. The practice previous to the installation of the new equipment was up to modern standards. The melting apparatus and methods formerly used were described in THE FOUNDRY Sept. 15, 1920, in which article the entire process of making British rail chairs was completely covered.

Weighing Made Easy

The new installation consists of two cupolas 56 inches in diameter inside of lining with a melting capacity of about nine tons per hour, charged mechanically by means of a skip bucket apparatus operating on a monorail trolley system, two balanced elevators being used to hoist the loaded skips to the charging floor level. Each skip or charging bucket is suspended from an automatic scale which constantly indicates the load being carried. As the buckets are filled in the yard it is only necessary for the workmen to load in enough charge to bring the scale pointer to a predetermined figure. Instead of loading first and weighing afterwards on a fixed scale, in which case the charge is frequently not adjusted to the exact weight, the weighing is done automatically while the bucket is being filled. It is just as easy, therefore, to load on the correct weight as some other automatic weighing of each charge as it is made up, and the even distribution secured by dumping alternately through chutes on opposite sides of the stack, it is believed account in a large measure for the results obtained. The apparatus installed at the Smith-Patterson foundry is based in part on a central European system of mechanical charging described in the July 15, 1920, issue of THE FOUNDRY. This fact illustrates the usefulness of the worldwide interchange of information on practical foundry methods made possible by THE FOUNDRY. In this case an apparatus invented in a late enemy country has been transplanted to England and there developed to a much greater state of perfection, these amount. The best way to do the job is also the easiest way, with the result that accurate weights are obtained and uniform charging assured. Furthermore until the load is dumped out of the bucket anyone passing by can see at a glance just what weight is being carried. The charges are correctly distributed in the cupola by being dumped alternately into hoppers on opposite sides of the stack. These hoppers chute the charge directly into the cupola, the ordinary charging door being eliminated.

These two features of the system, the

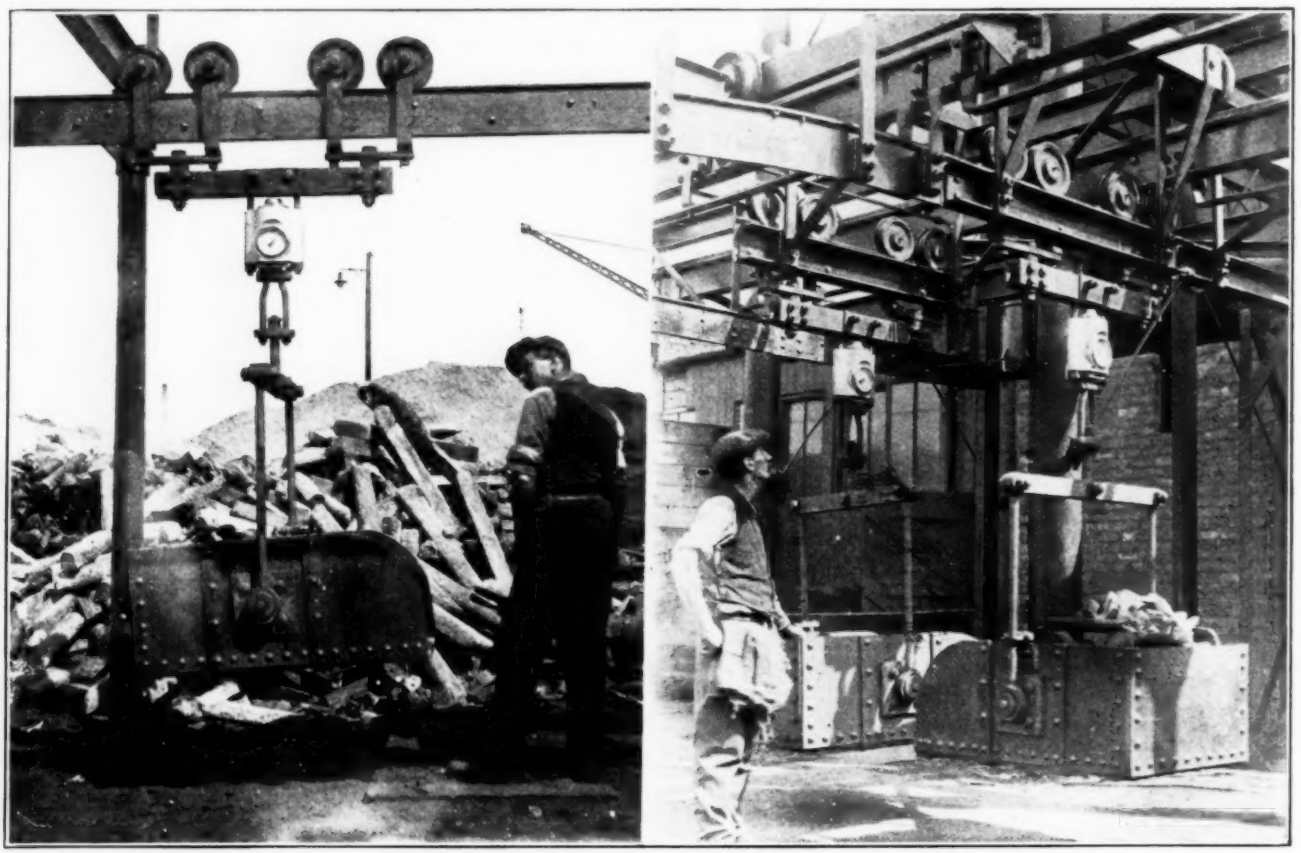

FIG. 2—THE CHARGING BUCKET IS LOADED UNTIL THE AUTOMATIC SCALE POINTER INDICATES THE CORRECT WEIGHT
FIG. 3—TRANSFER CRANE BY MEANS OF WHICH THE EMPTY BUCKET COMING DOWN IS SWITCHED OUT OF THE WAY OF THE LOADED ONE GOING UP

later details now being made public for the possible benefit of foundrymen confronted with similar problems in the United States, Canada, Australia or elsewhere.

The melting department of the Smith-Patterson rail-chair foundry now occupies a plot of ground alongside the shop about 100 feet long and 30 feet wide, one end of which is taken up by the cupolas and elevators, the remaining space, about 70 x 30 feet, constituting the yard for the storage of pig iron, scrap and coke. This yard, which is shown in Fig. 1, is traversed through the center by a pair of overhead monorails supported on cast-iron columns. The two monirail or trolley tracks, which are each about 75 feet long, are laid 5 feet apart, the bottom of the rail being 8 feet above the ground. The rail consists of an 8-inch rolled steel bulb flat, of the type used extensively in shipbuilding. The columns on which the runway is supported are spaced on 18-foot centers. They were cast on the premises. The runway serves the full length of the stock-yard, the coke, scrap and pig iron being piled along both sides.

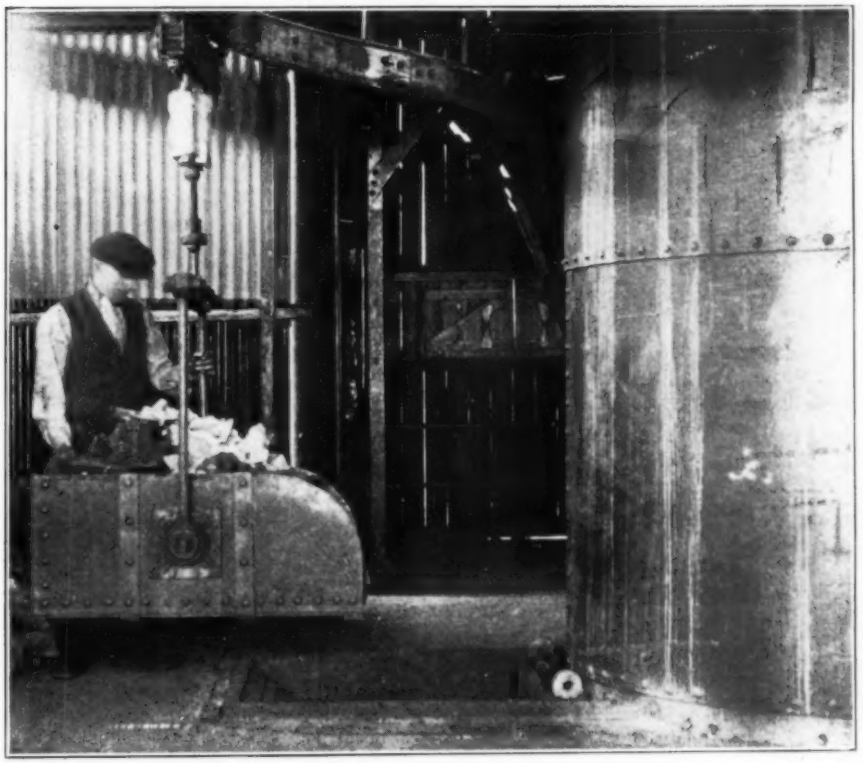

FIG. 4—ONE MAN IS ALL THAT IS NEEDED ON THE CHARGING FLOOR

Special Charging Buckets

Four charging buckets of the type shown in Figs. 2 and 3 operate on the monorail system, there usually being two on each track serving the opposite sides of the cupolas independently. The charging buckets are used for handling pig iron, scrap, and limestone only. The coke is handled in wheelbarrows, each load being weighed on an automatic scale. The buckets are of steel plate construction as shown, each one being 2 feet 6 inches deep from front to back, 3 feet 6 inches wide across the lip, with sides 18 inches high. The bucket is carried in a forged steel bail which is suspended from the hook of the automatic scale. The trunnions are so placed that the load almost dumps by itself when the bail catch *B*, Fig. 5, is released.

The self-reading spring scale with which each bucket is provided, has a capacity of 4000 pounds in increments of 50 pounds but can easily be read to 10 pounds. The scales were furnished by George Salter & Co., Birmingham, England. The bucket and scale are carried on a 4-wheel trolley shown in Fig. 2, which also illustrates the method of loading. The trolley is provided with Hyatt roller bearings and the fully loaded bucket can be easily pushed along by one man, the trolley rail being kept greased. The buckets weigh 625 pounds when empty.

The yard tracks lead directly to the elevators which carry a section of the trolley rail in addition to being provided to the usual platform for the accommodation of the coke barrows and miscellaneous freight. Just in front of the elevators on the ground is a transfer crane, shown in Fig. 3, by means of which the empty bucket returning to the stock yard is switched past the full one going up. This transfer is operated by hand in the manner illustrated.

The elevators are balanced so that only the net material charged is hoisted. Workmen, ordinarily, are forbidden to ride on the elevators, the charging floor being readily accessible by an iron stairway on the opposite side, as illustrated in Fig. 6. The lift is 28 feet and the

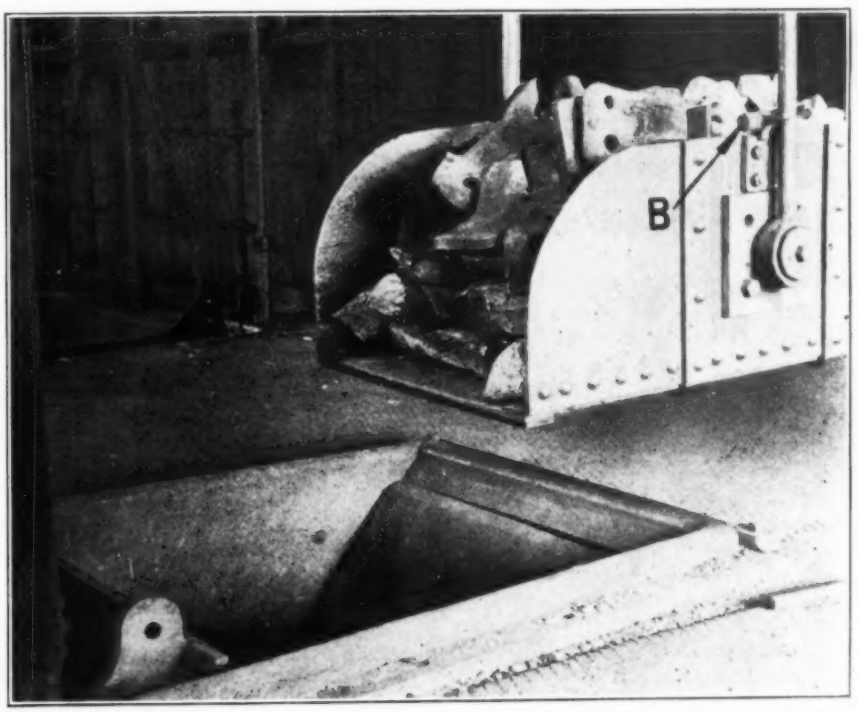

FIG. 5—DETAIL OF CHARGING BUCKET AND HOPPER THROUGH WHICH THE CHARGE IS CHUTED INTO THE CUPOLA STACK

elevator platforms are 6 x 7 feet. The hoisting mechanism consists of a 12-horsepower motor geared to a winding drum through a worm drive.

The charging platform, which is of steel-plate construction, is 30 x 32 feet. Its general arrangement is indicated in Fig. 4. The cupolas are placed centrally and the trolley tracks on each side connect direct with the elevators. The section of rail which joins up with that on the elevator is articulated, so that the lift does not have to be stopped at a precise point. The hoisting motor is stopped and started by means of an ordinary railway-type controller. The two trolley tracks on the charging floor are looped together around the cupola so

lined to 56 inches. The drop-bottom doors are 6 feet above the ground. The height of the shaft from the bottom to the lower edge of the charging hopper is 16 feet, the vertical height of the hopper along the side of the cupola being 6 feet. The charging floor is therefore 22 feet above the bottom of the cupolas and 20 feet 2 inches above the bottom of the tuyeres, which are set at a height of 22 inches. The effective height above the tuyeres, that is to the lower edge of the charging hoppers, is 14 feet 2 inches.. There is only one row of tuyeres which are made as continuous as possible.

The blast is furnished by a direct motor-driven fan furnished by the

terson company's own designs and is lined with loam instead of fireclay or bricks. It is suspended from a trolley so that it may readily be placed in front of whichever cupola is in operation. This part of the equipment is similar to that previously described.

For operating the whole charging system three men are employed in the stock yard loading up the charging buckets and coke burrows, while only one man is needed on the charging platform to operate the elevators and dump the loads. Two men have been eliminated, one man on the ground and one on the platform, the saving in wages being about £7 or $35 a week. A 12:1 melting ratio without the bed

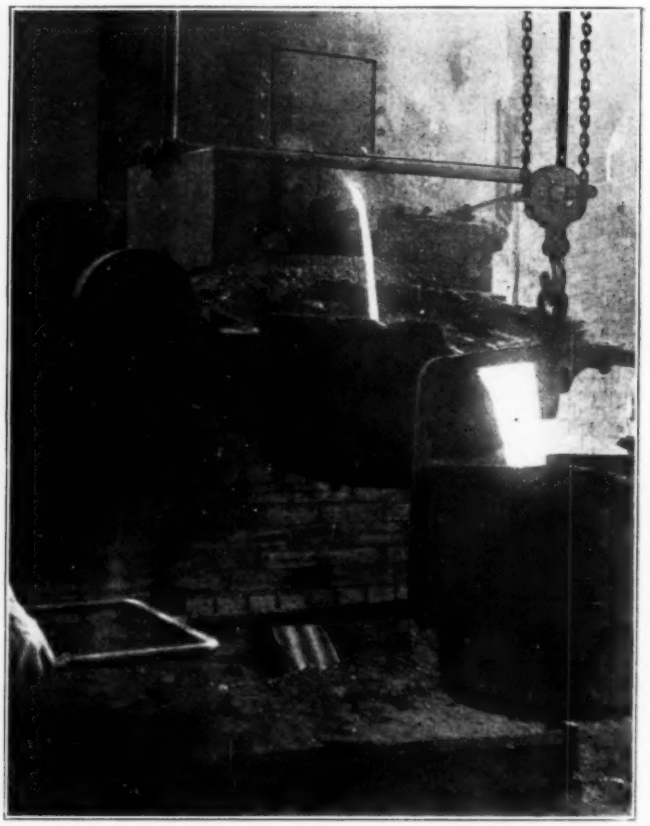

FIG. 6—GENERAL VIEW OF CUPOLA HOUSE SHOWING STAIRWAY TO CHARGING FLOOR FIG 7—THE IRON IS TAPPED INTO A CAP-SHAPED LADLE LINED WITH LOAM, FROM WHICH IT IS TRANSFERRED TO THE POURING LADLES

the buckets in an emergency can be transferred from one side to the other. The charging chutes, one of which is clearly shown in Fig. 5, are of steel plate construction with their lips level with the floor. The mouth of the hopper is 3 x 4 feet. It is protected by a hinged steel-plate cover. This is only for the safety of the men working in the cupola being prepared for the next day's heat, there being no back draft out of the hoppers. In fact there is a strong draft into the cupola stack through the charging hoppers.

The two cupolas are of the Whiting type with shells 78 inches in diameter

James Keith & Blackman Co., London. A 40-horsepower motor is employed. The blast pressure is equivalent to about 25 inches of water. The cupolas are operated on alternate days and when working supply metal to the floors continuously. The first metal is tapped at 7:30 a. m., and from that time until 4:45 p. m. the wind is not taken off except during the lunch hour. The tap hole is always open. The metal runs out into a cap shaped receiving ladle from which it is distributed into the pouring ladles. The receiving ladle has a capacity of about 3360 pounds. It is made of cast iron to the Smith-Patcharge is being maintained. The bed charge is 2240 pounds. The output is about 80 tons a day, the metal containing about 1.90 per cent silicon. Over two-thirds of the charge consists of scrap. Each charge weighs about 2175 pounds, the exact amount being altered from time to time according to the burden-bearing possibilities of the coke. About 50 pounds of limestone are charged per ton of metal. The coke charges ordinarily are 160 pounds each. A recent melting record was 441 tons in 48 hours. The melting system followed was suggested by David McLain, Goldsmith building, Milwaukee.

Simplifying Foundry Costs--I

Functions and Needs of Cost Finding Shown and Evils of Price Cutting Based on an Ignorance of Costs Are Pointed Out— Basic Terms Clearly Defined

BY ALFRED BARUCH

ACCURATE costs are essential to the successful operation of a foundry business in this age of sharp competition. Unfortunately many foundries do not have a simple system to enable them to predetermine their costs with accuracy. This leads to unfair competition and is a hinderance to the healthful growth of the foundry industry and penalizes the competing shop without benefiting the company operating in the dark. The cost system outlined in this series of articles is intended to be simple yet comprehensive and capable of being operated to give accurate costs. The first article of the series explains the functions of a cost system and gives clear definitions of the terms and phrases used so that the reader may get a clear idea of the elementary details before being introduced into the system proper as described in the later articles which include the production or order routine; the handling and recording of materials and supplies; collection and distribution of labor costs; analysis and distribution of indirect expense; and the reconciliation of costs with their special application to foundry work.

IN A FOUNDRY, the chief use of a cost system is to establish an accurate basis for future estimates. That is, the cost records must tell how much to charge in order to make a profit. This is done by keeping accurate check over the cost of labor, material and overhead, and by applying the three elements to the cost per unit in the right proportion. Cost keeping determines the percentage of overhead. It fixes the administrative and selling expense charge. It points out the classes of work that are profitable and those that are not. It shows just how low it is possible to go in fixing a price and still make a profit. It brings out the leaks by showing where all the money goes. *It measures the business.*

Only a highly efficient foundryman can make money when prices are low. Efficiency is the ratio between the work put in and the results obtained. To make profits a man must get more for his efforts than the amount of money he spends. This is obvious. But the way to do this is not so clear. Some factors, such as market conditions, are beyond the ordinary businessman's control, but the rest are in his own hands. He can do away with waste and he can prevent mistakes in bidding. The cost system is a great aid in either case. Under some existing conditions a foundry must have a cost system to stay in business.

The cost system is an actual necessity when business is not good and competition is close. That is, the time when it is necessary to cut prices in order to sell at all. Prices may not be cut without endangering the life of the business if a man does not know the cost of his products. This means the cost of the individual lines or classes of castings as well as the total cost. There is a foundryman in Long Island City who discovered the truth of this statement through a bitter experience. Although he kept no cost records, he had been consistently underbidding a competitor who, like himself, did both a stock and a jobbing business. Suddenly, this competitor gave up the stock castings altogether so that the first man took the whole business and had no more room for jobbing work. After he had rigged up special equipment and had been making stock castings entirely for a while, he discovered that he was producing below cost and had to change back, meanwhile taking a heavy loss for his outlay. His competitor who kept a cost system had discovered that the stock castings were being sold too low to pay and gave up that branch of the business.

Forced Into Bankruptcy

A foundry in Buffalo engaged in casting certain railroad accessories was actually forced into bankruptcy as a result of guessing at the price of a casting instead of knowing it. An order for 200,000 castings was advertised for bidding. This order was so large and involved so much money that the foundry we had in mind thought that there was no limit to the cuts in price that could be made without wiping out the profit. This foundry took the order at $7.00 and found to its sorrow that the average cost was $8.00 per casting. This loss of $200,000, which was made compulsory by an iron-clad contract was enough to put it out of business. A cost system would have prevented this mistake.

A cost system is also an absolute necessity when the business expands and becomes complicated. It is impossible for one man to carry all the details in his head. This is especially true in the foundry business because of the peculiar relations of the various departments to each other. For example, sand blasting and cleaning which are necessary operations in the production of castings must depend on the molding to measure the amount of work to be done and therefore the cost. If a man wishes to expand his business gradually he ought to have the skeleton of a cost system from the very beginning. Then it does not become necessary to break down established customs to start one. A foundry near New York that found it imperative to install a cost system when competition became unusually stiff had to let its superintendent go because he had become so accustomed to the old methods that he could not change to the new. A cost system provides for accuracy that no memory method, however efficient it may be, can possibly compete with. The only intelligent way to fix prices is on the basis of past performance and there is no superintendent who can commit to memory all the classes of work that pass through the shop of a jobbing foundryman.

A cost system is invaluable when a quick accounting of the business is needed. It may be necessary to borrow money from

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the bank. No bank will lend to a business that cannot show complete and detailed records. In case of a fire it is much easier to collect insurance if there are ample records to back up the claim. A cost system serves as a check on labor. It shows which men do the best work and the capacity of each man. This is an invaluable aid in taking on new work as well as in getting the best results possible from the men and the equipment.

Gives a Standard

One of the chief advantages of the cost system is that it tends to produce a standard cost per unit—pound, class, or casting. This is especially important in the jobbing business because a price that is fixed before the castings are made cannot be raised afterwards. If the bid was too low the foundry must take the loss. Standard costs will be defined later. The cost system also fixes the price scientifically and does away with guessing. Most foundrymen know the cost of metal at the spout pretty well. They also know the cost of labor per day. But they do not know, as a rule, how much to add on for overhead and the basis on which to add it. The cost system is also an aid to business policies. A man may wish to cut his price in order to fill his floors and get full use of his men. Unless he knows the cost exactly he cannot do this safely without risking his business. A cost system eliminates waste by pointing out existing inefficiencies.

Cost systems make for intelligent competition. Probably every foundryman who has met others in competition has had the experience of being faced with a bid that is even below his cost of labor and metal. The cause for this condition is ignorance of costs on the part of some of the men competing. Through the medium of a uniform cost system, the foundryman can determine his limitations. Uniform cost methods put competitors on the same footing and enable them to talk the same language. This does not mean that a uniform system results in a price agreement. It means that each foundryman will include all the items of expense in his cost and that the only difference between one man's bid and another's will be the difference in their respective operating efficiency.

Levels Prices

A uniform cost system therefore will tend to level prices, which would have a stabilizing effect on them as well as on the market in general. The only men affected by this movement will be the inefficient producers who will be driven to change their methods or else to get out of business.

To make the system clear, some of the terms and principles used are defined in advance. The following principles and definitions do not apply to all industries but only to the foundry costs and to work of a similar nature. These definitions are:

Departmentalization—This means the division of the foundry operations into departments for purposes of cost keeping. That is, each of the major operations or processes are made into little businesses that are held entirely responsible for the expenses they incur and the mistakes they make. This is made necessary by the fact that the method of figuring the cost of the metal at the spout is different from that used to determine the molding cost. In the following list of departments it is assumed that the foundry for which this system is written does both a stock and jobbing business and that on its stock products it has one or two finishing operations that the ordinary casting does not have. This type of foundry is selected for purposes of illustration only, and as the cost of each department will be illustrated separately, each man can select from the list only those operations that he performs and build his cost system on them. By stock castings we mean any type that is turned out as a regular product of the foundry and for which special equipment has to be installed. The stock castings are made first and sold afterwards. The jobbing castings are made according to orders obtained through competitive bidding. The departments follow:

Melting
Coremaking
Molding
Sand blasting
Cleaning
Repairing
Japanning

Type of System—Owing to the peculiar nature of foundry production it is necessary to adopt a system which is a combination of two established methods for finding costs, namely, the productive hour method and the process cost method.

Productive Hour Method—The productive hour method bases the cost on the value of the work that a productive man does in an hour. For example, if a molder gets paid $1 per hour and his overhead average 40 per cent, then each hour that a job requires would be charged with $1.40 while in the molding department. The departments that use this method are:

Coremaking
Molding
Sand blasting

Process Cost Method—This method bases the cost on the pieces that pass through a department in a given period rather than on the time required to produce them. For example, if the cupola melts 50 tons of iron a day then all the expenses in connection with operating the cupola for one day would be divided by 50 and added to the cost of the iron. The departments, in the list given, that require this method are:

Melting
Repairing
Japanning

Standard Hour Costs—The standard hour cost is the predetermined cost for each department where the productive hour method is used. This is arrived at by averaging the cost for each department for a year or more. If one year's costs are available the number of working hours during that year (the number of men times the hours for one man for one year) are divided into the total so as to arrive at the cost for one hour.

Departmental Burden—This expense consists of all indirect labor, supplies, and other expenses chargeable to the individual departments.

Pig Handling—All expenses incurred in unloading the iron, stacking it up, and delivering it to the cupola must be added to the cost of the iron.

General Foundry Expense—This is the sum of all expenses immediately connected with production which cannot be charged directly to a department or to an order, and must therefore be apportioned over all departments on the basis of total departmental labor hours.

Administrative and Selling Expense—This is the sum of all general administrative and commercial expenses. Selling costs are included in this group because foundry selling costs are usually so low that they do not warrant separate distribution. These expenses are charged to the cost of each order on the basis of a percentage of the total foundry cost; that is, the sum of the cost of metal, labor and burden.

Apportioned Expenses—These are all other expenses which cannot be charged directly to a job or a department and therefore must be apportioned to the individual departments on the following basis:

Heat expense is distributed to each department on the number of square feet of floor space occupied.
Light expense is distributed to each department on the basis of the wattage consumed in a normal day. This may be arrived at by meters, or, as second choice, by the number of lamps and the capacity of each. Power is distributed to each

department on the basis of the horsepower of the motors times the number of hours these motors are in use.

Compressed air is distributed on the basis of the number of cubic feet used.

Insurance on stock is distributed according to value. Compensation insurance is distributed on the basis of the payroll.

Depreciation—This expense for wear and obsolescence is distributed to each department according to the investment in wasting assets. The basis of value is the original cost plus all equipment and fixtures. The rate to be used for foundry equipment is so varied that it is impossible to make a brief statement of it. A complete table of depreciation for foundry equipment based on the best experience to date will be published in a later article.

Delivery Charges—This expense must be included in the general overhead.

Interest on Plant Investment—The inclusion of interest on investment is recommended wherever the interest acts as a substitute for rent or for labor saving devices such as molding machines.

Defective Work—Defective work is charged to the individual department according to each one's share, as indicated by the production reports. Where this information is difficult to obtain, defective work may be charged to the general overhead although this practice is less desirable.

Normal Rates—The rates to be charged for burden or overhead expense are predetermined; that is, the experience of as many years as possible is used in calculating what this expense should be in the future. For example, the average burden for the molding department for the past 3 years may have been $.40 per hour. This rate is adopted for this department and is used regardless of actual conditions until the end of the year when a new rate is determined based on 4 years experience.

The normal rate in the system outlined in these articles is the indirect expense for a department working at 80 per cent capacity. That is, the normal working hours in the molding department, all floors being considered, may be 5000 per month and the indirect expense for a month is shown to average $1600. Instead of dividing the $1600 by 5000 to get the rate per hour, it is divided by 80 per cent of 5000, or 4000 hours. If the orders are low and the molding department works only 3000 hours during the month, each job is still charged with $.40 per hour although the actual burden has risen to $.53 1/3 per hour. If the department works 5000 hours, each job is charged with $.40 per hour although the burden rate has dropped to $.32. This is known as, *maintaining the normal rate*, and is the only safe practice for a jobbing foundry.

Under the system described here no tieup is effected between the general books and the cost records although a detailed analysis of the costs, especially of the indirect expenses makes it possible to cover all expense with a single account in the general books, the details of this account being shown by the cost records.

Book Review

The Modern Iron Foundry, by Joseph G. Horner; cloth, 255 pages, 5½ x 8½; published by Oxford University Press, American Branch, New York; and for sale by THE FOUNDRY; price $5 net.

This English book, written from the standpoint of the workshop, with the intention of helping the workman, contains some points of interest for every foundryman, but is of especial interest to the apprentice or the molder without a great deal of technical knowledge. Every phase of gray-iron foundry practice is touched upon, and while no division is taken up in great detail, the basic principles are explained in a clear comprehensive manner. Also, every phase of the production of gray-iron castings is included. The brief description of the effects of the elements in iron, in the first chapter leads the student to a better understanding of the cupola practice including fans, blowers and fuel, explained in following chapters.

Sands and molder's tools are dealt with before the reader is introduced to molding practice. This is first explained in its elementary phases before machine molding is taken up in its different forms. Profuse illustrations are of great assistance in making the various descriptions clear. Not only is sand molding explained but the principles of the permanent mold and of die molding are outlined.

One chapter is devoted to cleaning methods and equipment, while foundry defects and their remedy are discussed in another chapter. Also, the question of design and equipment being vital to the successful operation of a foundry, these are dealt with briefly in the concluding chapter.

Thus covering the entire field of gray-iron foundry operations, in a simple and easily understandable manner, the book would give any apprentice or molder a clear idea of the processes which enter into the production of gray-iron castings.

Hard Spots in Piston Ring Castings

By H. E. Diller

Question—We are sending you a few samples of our piston ring castings. Recently we have had more or less trouble with hard or chilled spots occurring in these castings. We do not believe these spots are caused by wet sand because we use our sand just as dry as it possibly can be used. However, the defects undoubtedly are due to our iron but we have been unable to determine just what causes this chemical change to occur in our rings of smaller dimensions.

The iron must necessarily be extremely hot, and therefore we find it necessary to use 250 pounds of coke between 1400-pound charges of metal. Our iron is poured into 800-pound ladles from which it is delivered to the hand ladles at each individual floor. This we believe should mix the iron thoroughly. The peculiar thing about this trouble is that the chill spots occur at irregular intervals and only in the small rings.

Our iron is analyzed every day and averages about as follows:

	Per Cent
Silicon	3.18
Sulphur	0.094
Phosphorus	0.68
Manganese	0.71

Answer—To avoid the chill you should use iron in the casting with 2.75 to 3 per cent silicon and if the sulphur comes above 0.09 per cent it would be beneficial to add 3 or 4 pounds of pea-size 80 per cent ferromanganese to a thousand pounds of metal in the ladle. The addition of about an ounce of aluminum per hundred pounds of metal will also be a benefit in preventing chills. Also, the iron should be poured hot.

A Correction

Omission was made of the footnote prepared for the article published on pages 438 to 443 in the June 1 issue of THE FOUNDRY. This footnote explained that the article is from a symposium contributed by various authors at the Cleveland convention of the American Foundrymen's association.

Harry Collinson has been appointed district sales manager in charge of the Milwaukee office and warehouse of the Carborundum Co., Niagara Falls, N. Y. He succeeds J. H. Jackson who has resigned. Previously to his appointment in Milwaukee, Mr. Collinson represented the Carborundum Co. in Ontario. He has been succeeded by C. E. Bowman who lately was connected with the sales department of Norman MacDonald agent for the Carborundum Co. at Toronto, Ont.

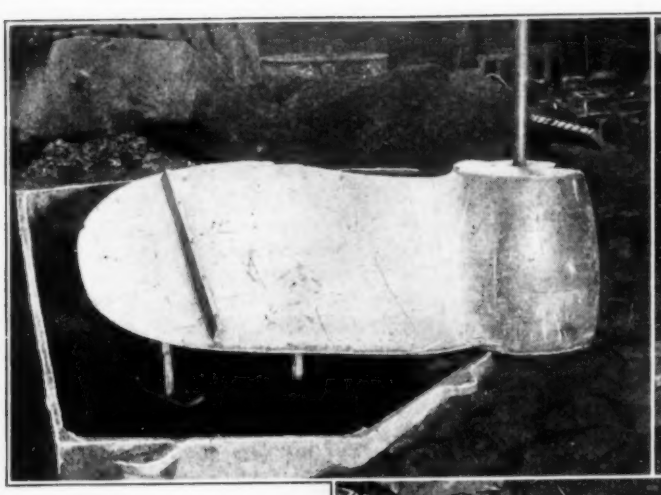
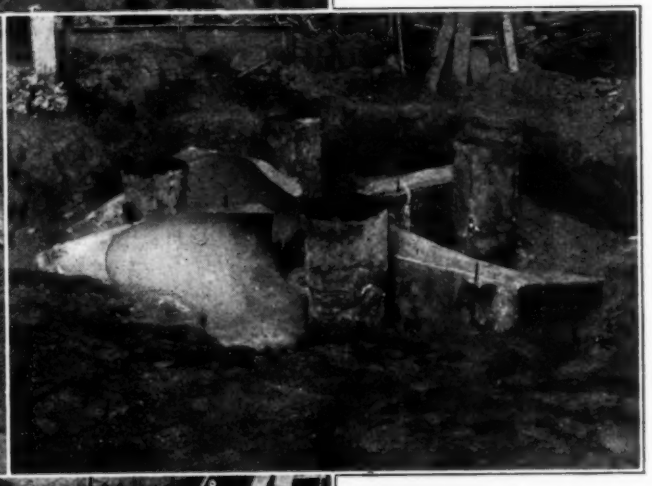


FIG. 1—ABOVE—PORT WHEEL PATTERN FIG. 3—LOOSE CHUCKS BOLTED TO THE NARROW END OF THE COPE CARRY THE OVERHANG

FIG. 2—ABOVE—STARBOARD WHEEL PATTERN SHOWING THE CONTACT WITH THE PORT WHEEL PATTERN SHOWN IN FIG. 1



FIGS. 4 AND 5—IN THE ROW ABOVE—THE DRAGS ARE DRIED WITH COKE-FIRED SALAMANDERS

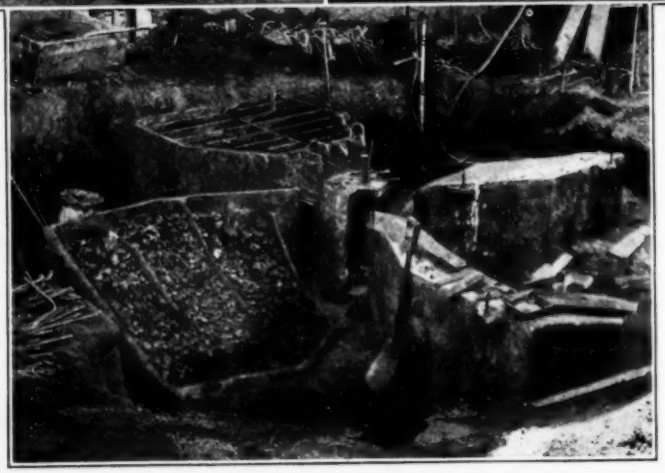


FIG. 6—AT THE LEFT—A LAYER OF CINDERS IN THE DRAG HELPS TO DRY AND VENT THE MOLD

Propeller Molding Is Varied

The Methods Adopted in Molding Four Standard Wheels, While Similar in General Principle, Differ To a Considerable Extent in Many of the Details Essential to Making of the Molds

BY R. H. PALMER

PROPELLER wheels naturally fall into two general classes or divisions right and left hand, which are also referred to as starboard and port. The distinction is caused by the direction of rotation when viewed by an observer facing the bow, thus a right hand, or starboard wheel, turns in the same direction as the hands on a watch and the left hand, or port wheel, turns in the opposite direction. Single screw steamers are equipped with right hand wheels and twin screw steamers, of course, are propelled by two wheels, one right and one left, located one on each side of the stern. As the greater number of steamers are of the single screw type it follows that nearly all the propellers made are right hand. The outstanding points of difference between the two wheels are illustrated in Figs. 1 and 2. The mold shown in various stages of progress is formed from the port which pattern, Fig. 1 and the casting made in this mold is shown in Fig. 16. The pattern for a starboard wheel is shown in Fig. 2 and the castings in Figs. 17 and 18. All the molds are made in flasks of the same design as those shown for the port wheel, but owing to the difference in hubs, blades and pitch minor adjustments in the molding procedure are required in nearly every case. The successive steps in making a propeller mold are shown in the accompanying illustrations commencing with Fig. 1, showing the pattern adjusted over the first drag, and ending with Fig. 15, showing the molten iron entering the runner basin.

The method of adjusting the pattern in the drag is shown in Fig. 7. It will be noted that a flat core *A* is tucked under the hub and the spindle projects through both core and hub. Fig. 3 shows the general layout of the mold with two copes removed, the pattern in place, the cope all set for the third blade, and the fourth drag empty. The cinder bed in the drag which serves the triple purpose of offering free egress to the steam generated in drying the mold, gas while the mold is filling with iron and a saving in the amount of sand required to be rammed in the drag, is shown in Fig. 6. A thickness of sand is rammed over the cinders conforming closely to the shape of the blade before the pattern is lowered into place.

Locating the Pattern

The square shown at *B* Fig. 7 is used to locate the wings 90 degrees apart. With a 3-wing wheel a similar device having the arms set to a 120-degree angle would be employed. After the first cope is hoisted off the mark *C* on the pattern Fig. 7, is transferred to the joint. The pattern then is lifted and lowered approximately into the proper [illegible] in the drag and bolted down and then the pattern is wedged up underneath until the gage block *F* shows that it is the required distance below the straightedge square. A row of wedges are inserted on the upper side between the pattern and the binder and then the pattern appears as in Fig. 8 ready for the facing sand on the drag side. After the sand has been rammed firmly under and around the pattern a joint is made conforming to the shape of the blade rim, the cope is rammed lifted off and finished, the mark *C* again is transferred to the joint and the foregoing process repeated on the two remaining wings.

The flasks [illegible] in the illustrations have been used [illegible] some 20 different patterns [illegible] pitches and diameters. The [illegible] approach the patterns closely, [illegible] ad, hanging

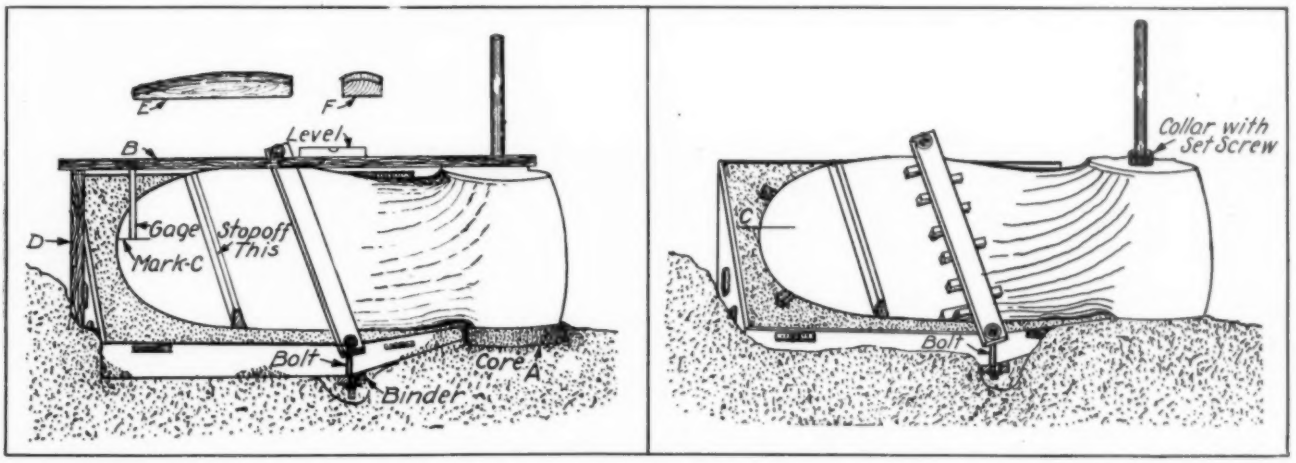


FIG. 7—A LONG WOODEN SQUARE, A SHORT STEEL SQUARE AND A LEVEL ARE EMPLOYED TO ADJUST THE PATTERN IN RELATION TO THE REMAINING BLADES FIG. 8—AFTER THE PATTERN HAS BEEN ADJUSTED IT IS WEDGED UP AND DOWN AGAINST AN IRON BINDER EXTENDING ACROSS THE DRAG

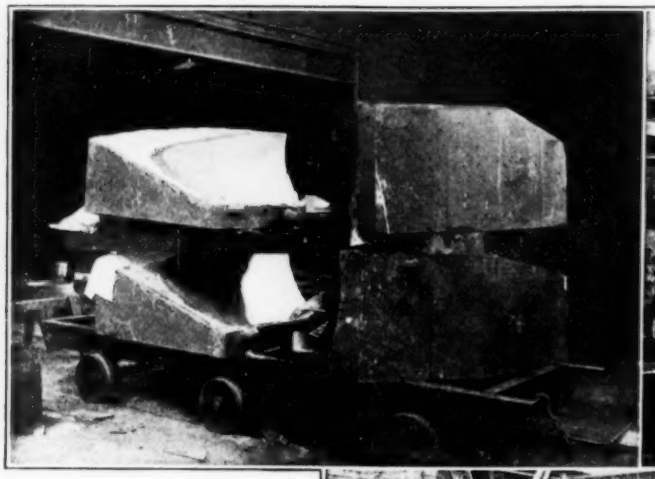


FIG. 9—ABOVE—THE COPES ARE DRIED IN THE OVEN FIG. 11—AT THE RIGHT—SAND IS RAMMED AROUND THE MOLD AFTER THE COPE IS CLOSED

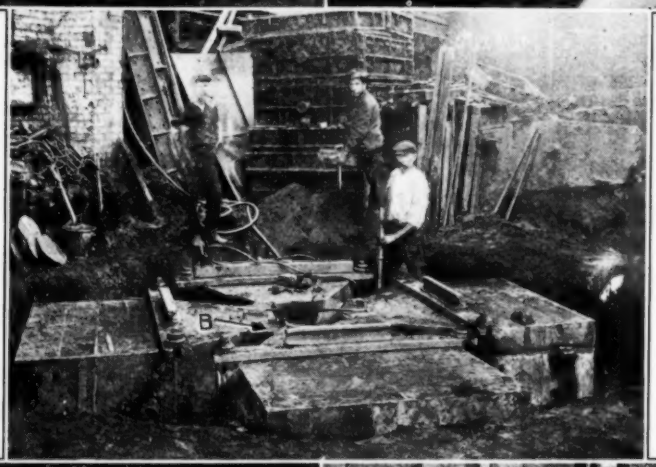
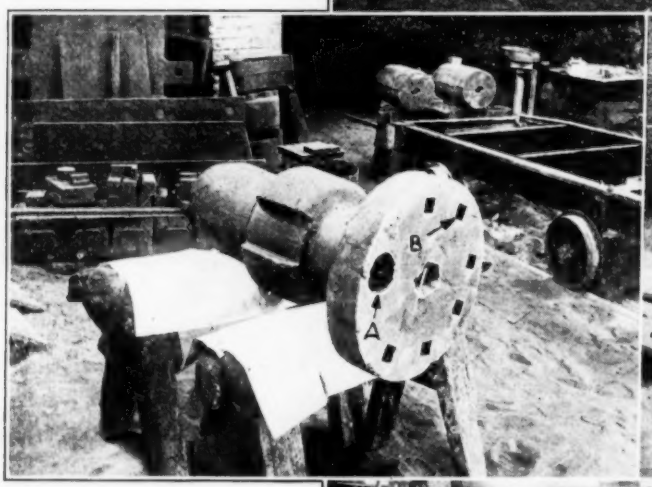
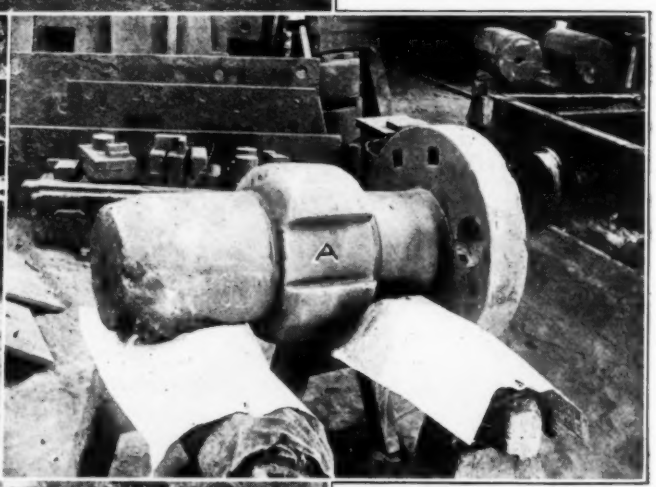


FIG. 10—ABOVE—THE CENTER CORE IS MADE IN HALVES WITH A SKELETON COREBOX AND SWEEP — THE FLAT TOP SERVES AS A COVER FOR THE HUB





FIGS. 12 AND 13—IN THE ROW ABOVE — SIDE AND END VIEW OF THE CENTER CORE

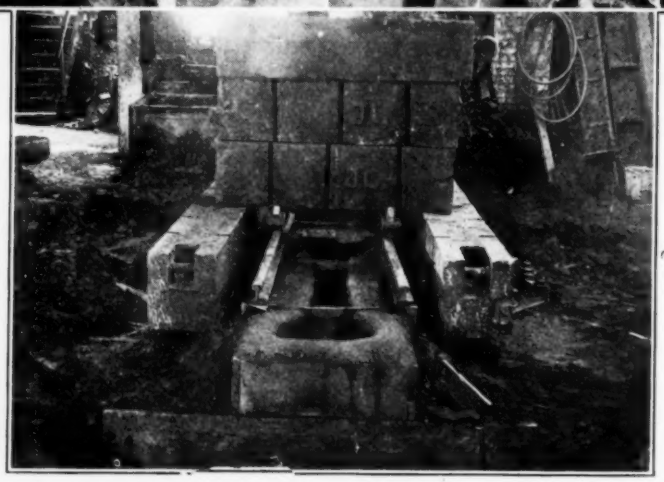


FIG. 14—AT THE LEFT — DETAILS OF THE RUNNER BASIN AND WEIGHTING THE MOLD

FIG. 15—HEAVY WEIGHTS ARE PLACED TO PREVENT THE COPE FROM RISING WHEN THE PROPELLER IS POURED
FIG 16—CASTING AS IT APPEARS WHEN LIFTED FROM THE SAND

chucks supplemented with hooked gaggers are employed to carry the sand in the cope. The amount of hanging sand on the narrow ends of some of these copes may be noted by referring to Fig. 9. It is still more apparent if the illustration is viewed upside down. The method of attaching the loose chucks designed to carry this sand is shown at *D* Fig. 3.

The mold is shown one step further ahead in Fig. 6 than it was in Fig. 3. The third cope is rammed, ready to come off and the cinder bed has been placed in the fourth drag. Figs. 4 and 5 illustrate the method of drying the drag mold with four coke burning salamanders. The copes are dried in the oven.

The drag is vented in each case before the pattern is withdrawn. On the first three drags the pattern may be swung around on the spindle, but after the fourth drag is rammed the spindle is removed first and then the hub of the pattern is tipped slightly and drawn forward to clear the overhang. Usually it is necessary also to lift the cope at a slight angle from the horizontal.

Several peculiar features of the center core are shown in Figs. 10, 12 and 13. The two halves of the core are made in the skeleton corebox Fig. 10. A loose piece shifted from side to side to make right and left hand halves, serves to form the gap shown at *A*, Fig. 13. The round flat head of the core covers the hub and is provided with suitable openings *A* and *B* Fig. 12 which serve respectively as riser and runners. It will be noted that the riser *A* is located directly above the gap in the core chamber thus providing a clear space for the rod used in churning, or feeding the casting after it has been poured. In the machine shop, the key way by which the wheel is held on the shaft, is cut in this reinforced part of the hub.

Binders and Weights Used

The four copes closed and held down by a single binder each are shown in Fig. 11. Bolts also are inserted in the pin holes and in addition as shown in Fig. 14 a number of weights are employed to prevent the copes from lifting under the pressure of the molten iron in the mold. Before the weights are put on, the stop-off piece *F*, Fig. 7 is used while filling in the gaps in the hub between the four copes. The top of the block in position may be seen at *B*, Fig. 11. These patches are blacked and dried by a small coke salamander while the men are filling and ramming sand in the pit surrounding the flasks. The center core then is set and provision made for holding it down by suitable flat bars. The casting ready to be chipped is shown in Fig. 16. As stated previously it is a port wheel. The companion starboard wheel is shown in Fig. 17. The white lines *A* and *B* chalked on the hub of the wheel shown in Fig. 17 indicate the space between each pair of wings that had to be filled in after the copes were set on the drags. The parting line where the blade joins the hub is indicated at *C*, Fig. 17.

The hub of the port wheel shown in Fig. 18 presented an interesting problem. In the illustration the wheel is shown turned over from the position in which it was cast, and with the counterbore up, ready to go on the boring mill of the machine shop. In molding all the other wheels outlined, the design of the hub allows *coping* all the way, or almost, to the bottom. In this case it cannot be done on account of the *under cut* and it becomes necessary to provide other means of forming that part of the hub below the line *A*. Before setting each cope in position a small space is cleared away between two drags and flush with the bottom face of the hub. A piece of thin plate is laid on this parting and a quantity of sand rammed on top of it. This body of sand is scraped away with the trowel until the top edge follows line *A* and the bottom tapers away to nothing.

(*Continued on Page* 490)

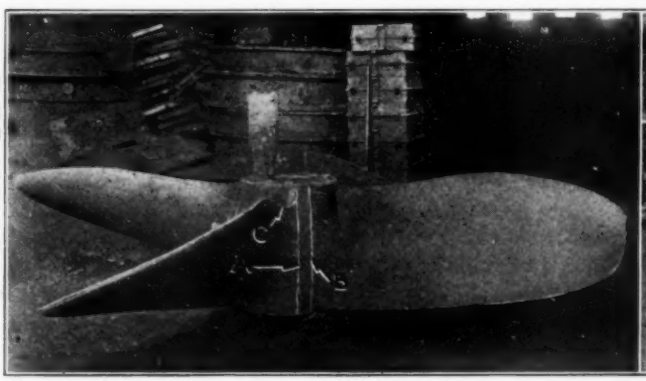


FIG. 17—THE CHALK MARKS ON THE SIDE OF THE HUB INDICATE THE PART THAT WAS MADE UP AFTER THE COPES WERE SET ON THE DRAGS FIG. 18—THIS STARBOARD WHEEL WAS MOLDED IN THE OPPOSITE POSITION TO THE ONE IT OCCUPIES IN THE ILLUSTRATION

Cleaning Steel Castings-III

Grinding Wheels Form An Important Factor in Cleaning Castings Properly—Selection and Care of Wheels Suggested —Safety Considerations Outlined

BY HERBERT R. SIMONDS

FOUNDRYMEN are not experts in grinding and for this reason often find themselves at sea in choosing the proper abrasive wheels for snagging operations. Experience is a teacher in this as in other matters, but often the instruction is costly and difficult to follow. In the accompanying article, the author outlines the principles which govern the proper choice of grinding wheels for snagging steel castings. Contrary to popular belief, softer abrasive material is required for steel than for other softer metals. The surface speed approximating 6000 feet per minute is recommended for vitrified wheels, and 8000 feet per minute for the so-called rubber wheels. Grain size may be specified and uniformity found among various manufacturers, but the grade of wheel, designated usually by letter, varies widely. Size and speed alike effect grinding economy. The writer recommends the purchase of large wheels which may be speeded up as they wear to give the same surface velocity as formerly was obtained. Grinding cost is affected by the speed with which metal is removed and by the cost of the wheel. Efficiency should not be sacrificed in the interest of lower grinding wheel expense. When the surface of the wheel loads, or becomes filled with the material being ground, the wheel speed should be increased. Safety requires that guards be provided to prevent accident through touching the surface of the grinding wheel, and also to prevent serious accident, should the wheel break while being revolved at high speed. Goggles should be worn by the operator to prevent injuries to the eyes from flying particles.—The Editors.

PROPER selection of grinding wheels is of paramount importance, and by reason of the great variety of standards available together with somewhat vague and mystical terms used to describe the wheels the problem is one of great difficulty.

In fact, in most cases the head of the cleaning department leaves the selection of wheels either to the wheel manufacturer's salesman, to the purchasing agent or someone else. Undoubtedly, if the foreman or superintendent is not reasonably sure of the exact properties which he should have in grinding wheels, he will do well to describe the conditions carefully and leave the selection to some reliable manufacturer. Conditions which affect the selection of wheels for steel snagging include the following:

Size and shape of casting.
Design and condition of grinding machine.
Finish desired.

Sometimes the design of a grinding machine determines the wheel speed, but usually this speed may be altered if the change is considered important. The size of wheel also may be limited by the machine design. Thus on a portable grinder, relatively small wheels must be used. The speed and size of a wheel have a direct bearing on the kind of wheel to be used under different conditions. Grinding wheel manufacturers publish descriptions of wheels which they suggest for different uses and also publish speeds

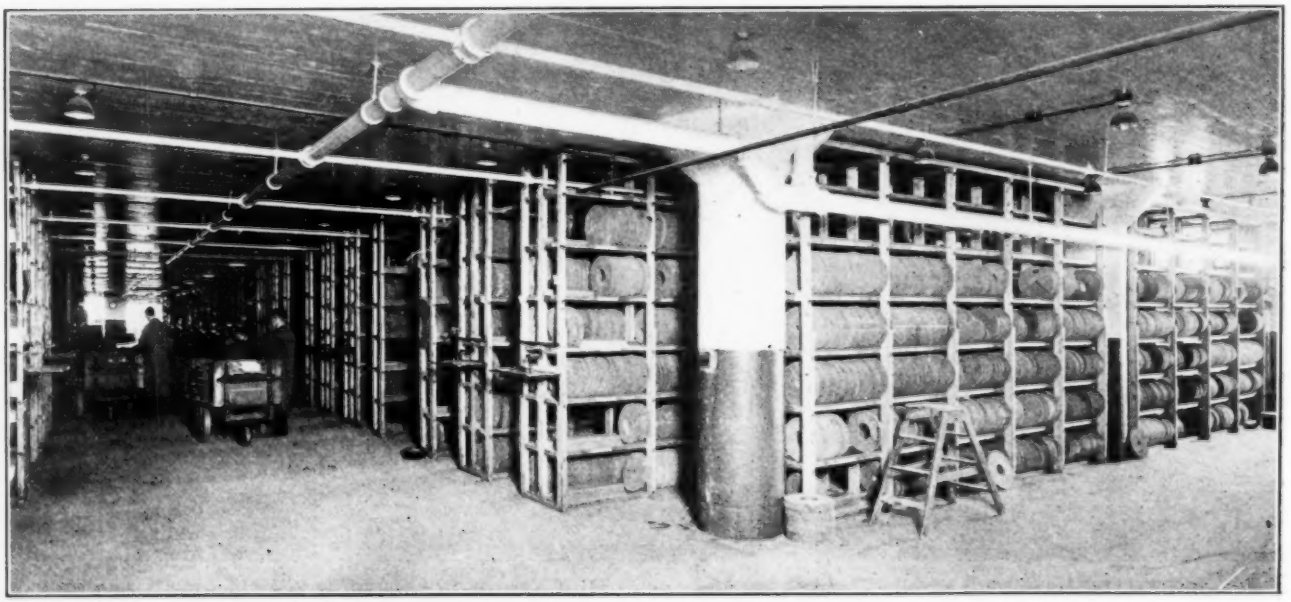


FIG. 1—CARE IN STORING GRINDING WHEELS CONSERVES TIME AND DECREASES BREAKAGE DUE TO HANDLING

for wheels used on different classes of tools. One company says snagging wheels should be operated at between 5000 and 6000 surface feet per minute. This applies to vitrified wheels. Rubber wheels should be operated considerably faster, one company recommending approximately 8000 surface feet per minute. One manfacturer states that proper speed for snagging is largely independent of the material which is being ground, but according to the experience of many plant foremen, it often is necessary to vary the speed in using the same wheel for different material. In genera , it may be said for steel snagging, a vitrified wheel should be operated at approximately 6000 surface feet per minute and a rubber wheel at approximately 8000 surface feet per minute. As a wheel wears down, and the revolutions per minute are kept contant, the surface speed decreases so that it is well to start the new wheel as high as is consistent with proper operation and safety and then as the wheel wears down, the reduced surface speed is not as noticeable as it would be if the initial speed were lower.

Contrary to what might be supposed by those not familiar with snagging practice, steel snagging requires for the best results a sof er abrasive material than is used for snagging softer metal. The explanation of this requires a little examination into the construction of grinding wheels. Many grinding wheel manufacturers use two types of abrasive and four or five types of bonding material. The two abrasives generally used which under slight variations are designated by a long list of trade names by the different manufacturers are silicon carbide and aluminus artificial abrasive. The silicon carbide has a sharp crystaline structure which is hard and brit'le. This is used for cast iron and other materials of low tensile strength. In operation, the particles cut into the material being ground, but break off rapidly enough to keep the face of the wheel clean. Aluminus abrasives, while softer, are tougher, and if used on cast iron do not break away fast enough to keep the wheel face from loading. It is this property of toughness which makes alumnus abrasives preferable for materials of high tensile strength such as steel and malleable iron castings. Wheels are made up by mixing abrasive parts of the desired size with some form of bonding material. The four principal types of wheels designated according to the different bonds are vitrified, silicate, elastic and rubber. While the bonding materials are made up according to formulas which are regarded as business secrets, the four types mentioned may be classified briefly according to the principal ingredient as follows:

Vitrified	Clay
Silicate	Water Glass
Elastic	Shellac
Rubber	Rubber

These bonding materials are made up in different degrees of hardness by changing the ingredients, and, therefore, it is necessary after selecting first type of abrasive, second the size of abrasive grain, and third the type of bonding material, then to select the hardness or grade of the bond, or as it is generally designated, the grade of the wheel. Many manufacturers publish lists of grain size and grade of wheels to use for different classes of work. Unfortunately, up to the present time, manufacturers of grinding wheels have not standardized

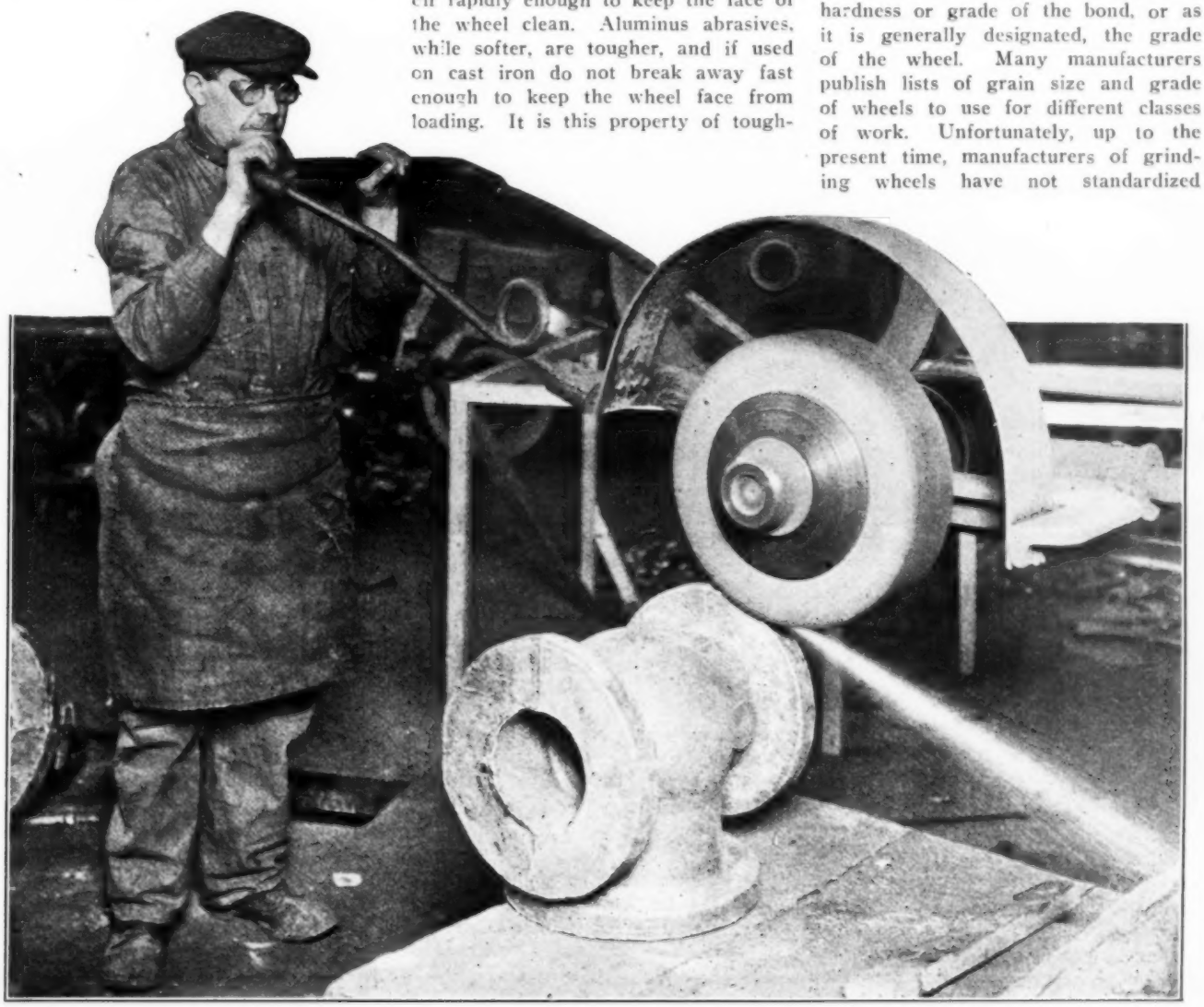


FIG. 2—CONVENIENCE SUGGESTS A PLATFORM FOR SUPPORTING MEDIUM SIZE CASTINGS DURING SNAGGING

grain sizes or grades, so that a foreman who knows the letter designating grade of one wheel is not always sure what letter to specify in buying a wheel of a different manufacturer.

The numbers designating grain are more nearly standard. For example, many manufacturers call grain 20 the size of grain which will pass an 18 mesh sieve and will be retained on a 20 mesh sieve, and correspondingly for other grains. Thus, a 14 grain indicates the size of abrasive particles which are held on a 14 mesh sieve, having passed through the next larger size of sieve.

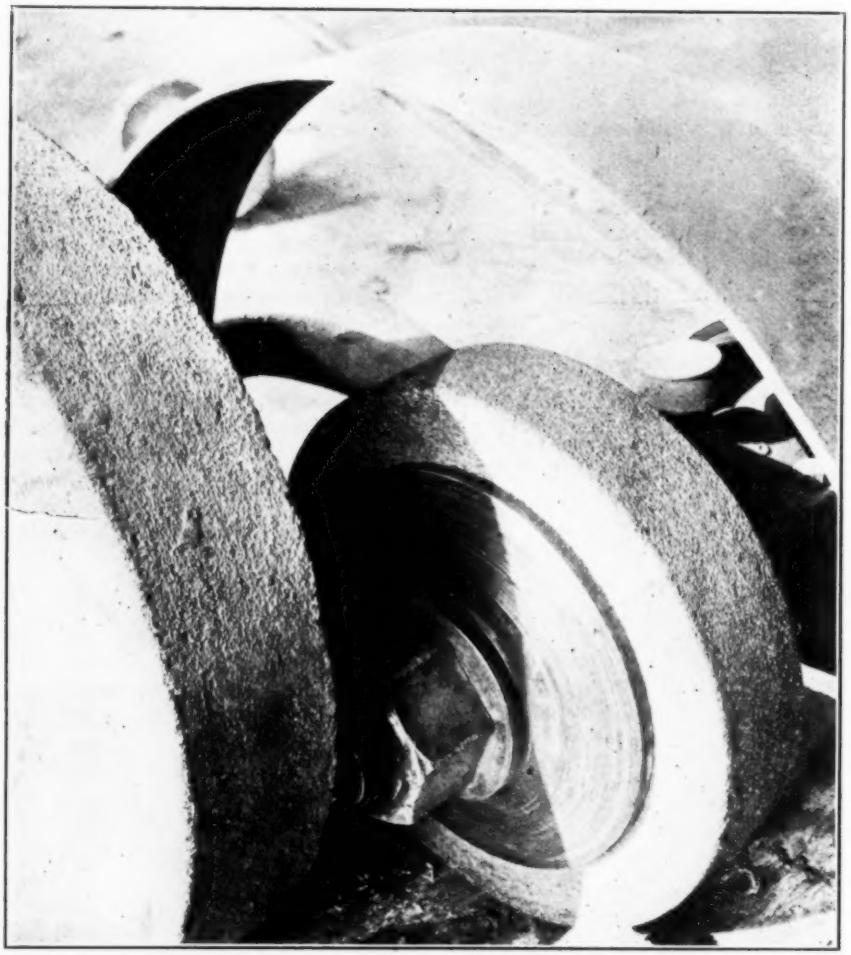


FIG. 3—AT THE LEFT IS THE ORIGINAL WHEEL WHILE AT THE RIGHT IS THE STUB READY FOR THE DISCARD

Grade is not so easily referred to a fixed standard. Each manufacturer keeps a set of standard wheels for use in grading each lot of wheels manufactured from a particular batch of bonding mixture. These different grades are designated in most cases by letter but here companies differ somewhat listing increasing hardness alphabetically and others in the reverse order. One company whose method of classification is followed by several others, advises for steel castings, grade *S* for swing frame snagging, grade *R* for floor-stand snagging and grade *Q* for bench stand snagging. In seven plants investigated, the grain size on swing frame grinders varied from 12 to 16.

Determination of the kind of wheel to use, that is, nature of the bond material for steel snagging work is still the subject of some discussion. Vitrified wheels probably are used for this work more than any other type of wheel. Elastic and rubber wheels are used in cutting off steel. One reason for this is that the material lends itself to the construction of an extremely thin wheel, thus reducing the loss of metal in cutting stock. Rubber wheels are often used in snagging rooms. The rubber bond wheel probably has a little easier feel for the man operating a swing frame grinder, but records of tests show that its efficiency in cutting is no greater than other wheels made up especially for snagging work, with a vitrified bond. Rubber bond wheels give off an unpleasant hot rubber smell which in a plant not well ventilated may be objectionable.

The size of wheel is the subject of much discussion among cleaning room foremen. In theory, the larger the wheel the greater the economy. This is because fewer stubs are left to be thrown away. If the wheel is large, its stub bears a smaller weight in proportion to the original wheel weight than where the original wheel is small. Take two wheels such as are commonly found in snagging rooms, each two inches thick, one 18 inches in diameter and the other 24 inches in diameter and assume that stubs are thrown away at an 8-inch diameter. It will be seen that the loss in the case of the smaller wheel is about 20 per cent of the new wheel weight and in the case of the larger wheel is only 11 per cent. Swing frame grinders usually use 18 and 20-inch wheels and floor stands 20 and 24-inch wheels. However, exceptions to these sizes often are found. In Fig. 2, the wheel used at the start is 24 inches in diameter and has a surface speed of 8300 feet per minute. The wheel is discarded when it is 16 inches in diameter and the operators says that the smaller diameter wheels cut just as well as the larger ones, providing the surface speed is kept approximately the same. The two wheels, the new wheel 24 inches in diameter and the old wheel ready to be discarded at 16 inches in diameter are shown in Fig. 3. To overcome the reduced surface speed in a wheel as it wears down, it is customary to group three or four machines each with a different shaft speed which compensates for the reduced wheel diameters. Thus a wheel when new will be operated at one speed. When it wears down to a certain point, the wheel will be transferred to a slightly higher-speed machine, and so on until the stub is thrown away.

What Snagging Costs

The snagging operation on the high pressure valve casting in Fig. 2 was accurately tested as to weight removed under definite conditions. The average of several tests showed a thickness of ½ inch over a space of 20 square inches, removed in 10 minutes. This means one cubic inch per minute or, reduced to pounds, means 0.28 pound per minute. The labor and overhead charge in this particular case amounted to approximately 3 cents per minute, which gives a cost of 13.8 cents per pound of metal removed.

Obviously, it is difficult to compare operations on a cost per pound basis because of the fact that complicated castings which must be ground on many sides require a great deal

more attention and time for removing, by means of a grinding wheel, the same weight of metal as might be removed from a heavy, simple casting of the same material.

For identical castings there should be some one method of snagging which would be most economical, yet even here it is almost impossible to designate the kind of wheel and speed which will give the best results. The reason for this is the big uncertain factor called the personal element. One operator will like a softer wheel than another and often will get better results with the wheel of his choice than with one which the superintendent may advise.

Wheel Life Charted

Nevertheless, it is well for the superintendent to understand that many of the opinons of the operators are arbitrary and that often in ignorance they are operating under disadvantageous conditions. Using different wheels on a fixed run of steel castings, a set of curves may be drawn showing the variation in production and in cost with a variation in wheel life. Such a set of curves based on experiment with 250 wheels is shown in Fig. 5. From this it will be seen that as the life of the wheel increases the wheel cost naturally decreases, but production also decreases and therefore the labor and overhead increases. The total cost decreases at first and then increases. This is the curve which should govern the choice of wheel. From the curves it will be seen that the total cost is lowest where the wheel life is about 12 hours. This determination of 12 hours should not be taken as applicable to all conditions. It was the value arrived at in one particular plant where overhead and rate of production may differ from other plants. It should always be borne in mind that the cost includes the three items, overhead, labor and grinding wheel costs. Considering any one of these alone gives a false value.

Because of the various types of wheels which are recommended for snagging under varying conditions, it is not uncommon for a new plant to run into some difficulties. Therefore, some generalities are well to keep in mind. If wheels act soft and wear out too quickly, the operator should not immediately change to harder wheels. Often a wheel which wears out quickly actually gives lower cost per pound of metal removed than a harder wheel. This is because the surface of a softer wheel with large rough abrasive particles does not load up as quickly as the surface of a harder wheel and, therefore, the grinding action is better. However, when the wheel seems too soft, it is well to try a harder wheel keeping always in mind that the basis of comparison should be the cost of removing a definite amount of metal.

Increasing the speed sometimes overcomes too rapid wearing away of soft wheels. Another item which is often overlooked is the solidity or lack of vibration in the wheel and machine. This feature was touched upon under design of machines. If wheels seem too hard the first thing to do is to reduce the speed. A hard wheel is only advisable in snagging when the castings have many thin fins or projections to be removed. Such fins would cut into the surface of a soft wheel and make frequent dressing necessary. Of course, this means high wheel cost. The finish desired is also a factor in determining the choice of wheel. If the only question is removing the metal then the coarser the wheel, within certain limits, the better. However, if a high finish is required a finer wheel must be used. Sometimes it is advantageous to put the castings through two operations, one on a coarse wheel and one on a fine wheel, but this is not a usual custom in work falling properly under the term snagging. The harder the material which is being ground, the finer the wheel can be to get maximum cutting effect due to its not loading. The loading of the grinding wheel is the filling up of the surface of the wheel with particles of the material which is being ground. When this occurs, the wheels should be speeded up, if not already above 5000 surface feet per minute for vitrified wheels and 8000 surface feet per minute for rubber wheels. If the wheel is already operating at a high rate of speed, a coarser wheel or a softer wheel or a wheel both coarser and softer should be used.

Danger from grinding wheels comes from three sources. (1) Particles of the wheel or of the material being ground may fly off and enter the eyes of the operator. (2) The wheel itself may break while in operation and the pieces fly apart with great force injuring those nearby. (3) The operator or others in the shop may be injured by coming in contact with the wheel in operation. To guard against the first difficulty, goggles should be worn by operators. To overcome the second danger, wheels wherever possible should be provided with strong steel cases. Fig. 4 shows a wheel guard or box made from ⅜-inch boiler plate. The wheel in this case is a 36-inch x 3-inch wheel which burst at a surface speed of 5372 feet per minute when in operation in a steel foundry. The pieces were prevented from flying or doing any harm by the guard. Lighter types of guards will answer the purpose in keeping those about the plant

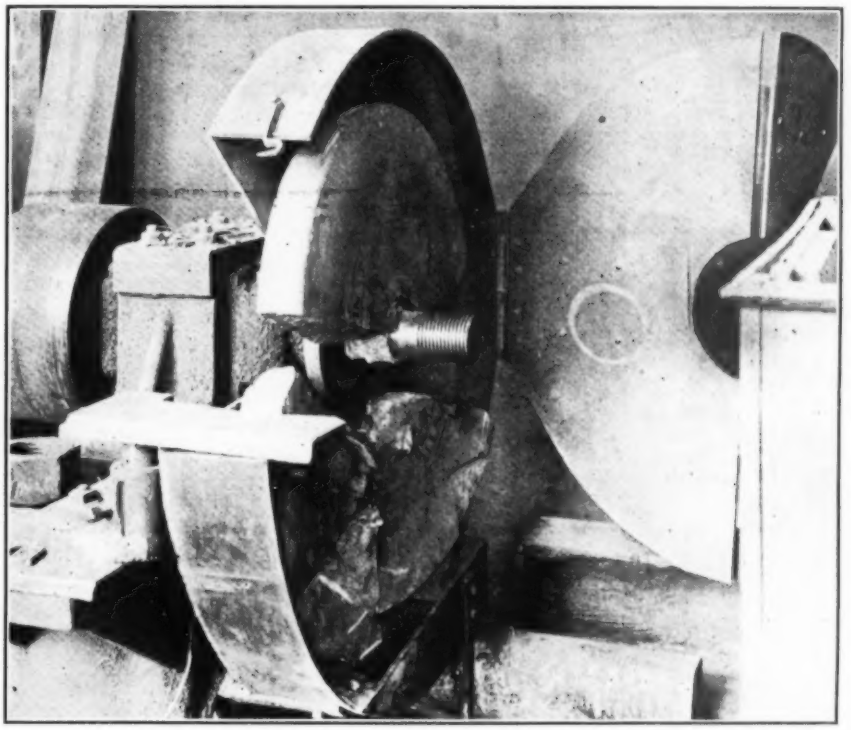


FIG. 4—THIS WHEEL BROKE AT A SPEED OF 5372 FEET PER MINUTE—THE STEEL GUARD PREVENTED SERIOUS INJURY AND PROPERTY DAMAGE

from coming in contact with the revolving wheels. Such guards usually are made of screening or woven wire.

The proper mounting of wheels has a most important bearing on the safe operation as well as upon efficiency. Wheels should never be run without flanges. In the ideal case, flanges one-half the diameter of the wheel are used. One manufacturer gives the following advice for correct mounting:

Use relieved flanges one-half the diameter of the wheel; compressible washers of pulp or rubber between wheel and flange; perfect bearing upon outer edge of flange; inner flange keyed or shrunk on spindle; surround wheel by protective hood; tighten flange only enough to hold wheels firmly; avoid any unnecessary strain.

General Care Urged

Unlike a planer or lathe, the grinding wheel in a general shop is the property of everyone and, therefore, often receives little or no care. However, in a snagging room, the machines are essentially machine tools and should be treated as such. Speeds should be checked occasionally to insure the most efficient operating conditions. The wheels themselves should be handled with care. Fig. 1 shows the construction of racks for storing grinding wheels in a plant of a large wheel manufacturer. This same type of rack can be adapted to storage in the foundry.

Propeller Molding Is Varied

(*Concluded from Page* 485)

This little mound of sand is covered with parting sand and the copes are rammed as already outlined. After each cope is lifted off, the plate supporting this undercut body of sand is removed and then the pattern may be lifted and swung around to the next position.

Flasks for the starboard wheels never are moved out of the pit. After an order is finished, the last casting is lifted out, then the copes are replaced approximately where they belong and the sand knocked out. The remainder of the pit is filled and leveled. The set of flasks shown were cast nearly 20 years ago and have been used quite extensively in the intervening years.

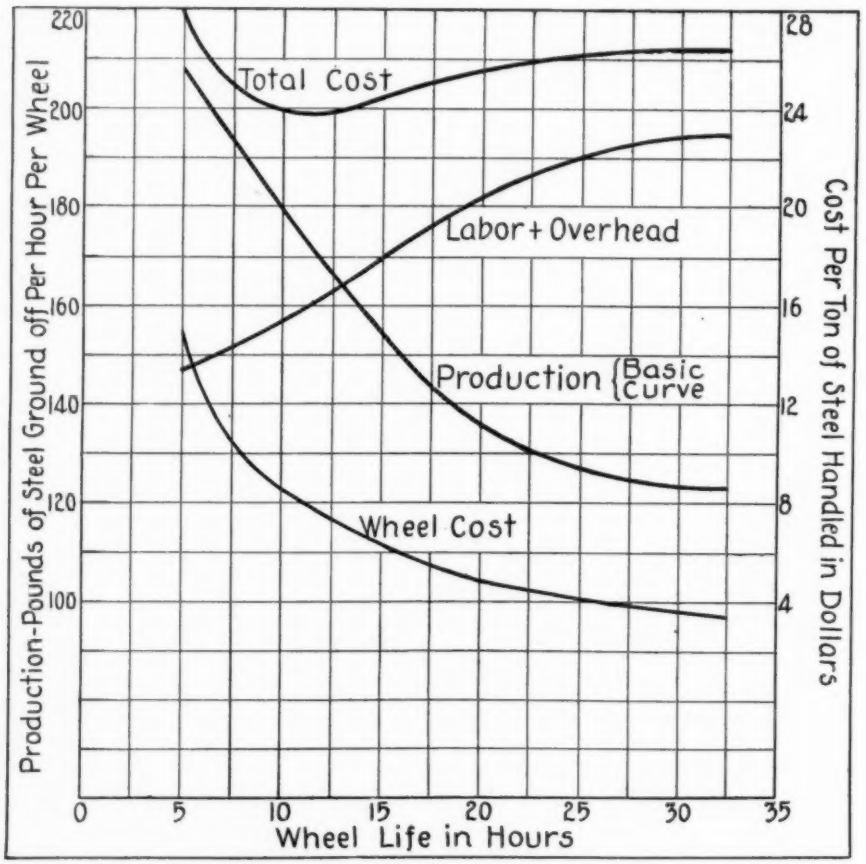


FIG. 5—THE RESULTS OF OVER 250 TESTS IN ONE PLATE UNDER DEFINITE CONDITIONS ARE CHARTED

J. H. Bricker is in charge of the Philadelphia office of the Northern Engineering Works, Detroit, at 51 Estey building.

Weld Enlarged Holes in Flask Lugs

By A. M. Candy

One of the most recent applications of arc welding in foundry practice is that of repairing flasks.

The holes in malleable iron lugs on flasks become worn to such a large diameter that the pin on the other half of the flask will not fit sufficiently tight to hold the parts in alignment. The practice in the past to make repairs has been to ream out the hole to a diameter of 7/8-inch and then press in a bushing having a 5/8-inch hole. When the bushing wears too large it is then replaced with a new bushing.

In the new method of repair the practice is to ream out the hole to 7/8-inch diameter and then fill it completely, using the metallic electrode arc welding process. A piece of copper is placed under the hole and the welding is done using about 175 amperes and 5/32-inch diameter welding wire. The time required to weld one hole is about 3 minutes.

When these holes are again worn oversize it is not necessary to ream them out before the welding operation. The time required to weld a hole is then reduced to about 2 minutes.

The cost of welding each hole as originally drilled to 7/8-inch diameter is about as follows:

Labor at 70c per hour	$0.035
Welding wire at 8c per pound	0.016
Electric power at 3c a K. W. H.	0.013
	$0.064

The question naturally arises as to why it is necessary to drill a 7/8-inch diameter hole in the casting when only a 5/8-inch diameter hole is required for the pin on the flask. The reason for this is that there will be a layer of hard chilled high-carbon cast steel about 1/16-inch thick in the region where the deposited metal unites with the casting, therefore it is necessary to have the original hole 1/4-inch larger in diameter than the final hole so that no difficulty will be experienced in drilling the final hole through the deposited metal.

The Gibb Instrument Co., Bay City, Mich., manufacturer of electric welding equipment, has opened a sales office in the General Motors building, Detroit. This office is in charge of F. M. Luchs, formerly chief engineer of the company.

Mold Hollow Brass Cylinders

Methods of Producing Different Types Are Outlined — Small Bronze Plungers Made in Three-Part Flasks—Temper of Sand Must Be Exact—Horizontal and Vertical Molding and Gating Methods Considered

BY CHARLES VICKERS

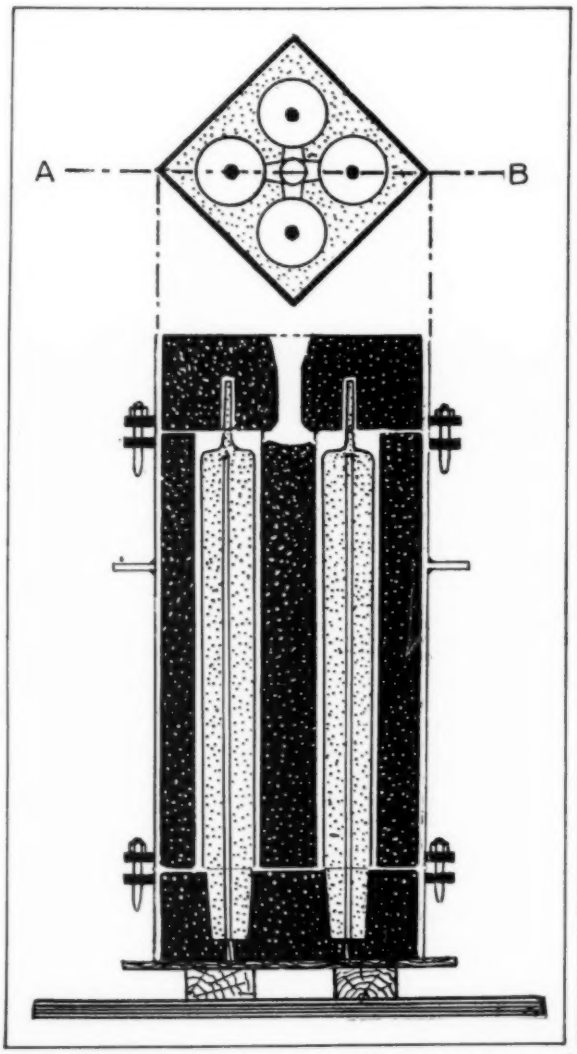
INCLUDED in the category of bushings is the type embracing plungers, sleeves, liners, turbine rings, and cloth printing rolls; all of which are cylindrical castings with hollow interiors. Fig. 1 shows the plan and vertical section of a mold for small plungers of bronze. These castings work with a reciprocal motion within a short iron cylinder and act as small pumps. The best way to mold them is with their length upright. Difficulty would be encountered in holding the cores centrally if molded horizontally, because of the small diameter of the coreprint on one end.

The illustration shows four patterns in a mold consisting of a three-parted flask having a deep cheek part. The important part of the operation of making molds is to use a free-venting molding sand, and to work it, in the cheek part more especially, much dryer than is usual; in fact, the sand is worked so dry, by those skilled in making such molds, that it would be impossible to make a mold horizontally in any of the standard brass-molding flasks. The cope would be sure to drop out, even if it was possible to lift it off intact.

Separate the Sand

Usually for such castings the sand pile is divided into two parts; one portion is tempered to the usual dampness for ramming the cope and drag, and the dryer sand is reserved for the cheeks. It is necessary to give notice a day or so ahead to the molder when changing to this work in order for him to have time to bring his sand pile to the proper degree of dampness, as water must be withheld from the part of the sand that is to be worked dryer than usual.

In molding these castings it is not necessary to place the patterns upside down on a match, or follow board, then ram up cheek and drag and roll the two over. The bottom board is placed down first, then the drag is set on this with the joint upward, and molding sand is rammed to a level bed at such a depth



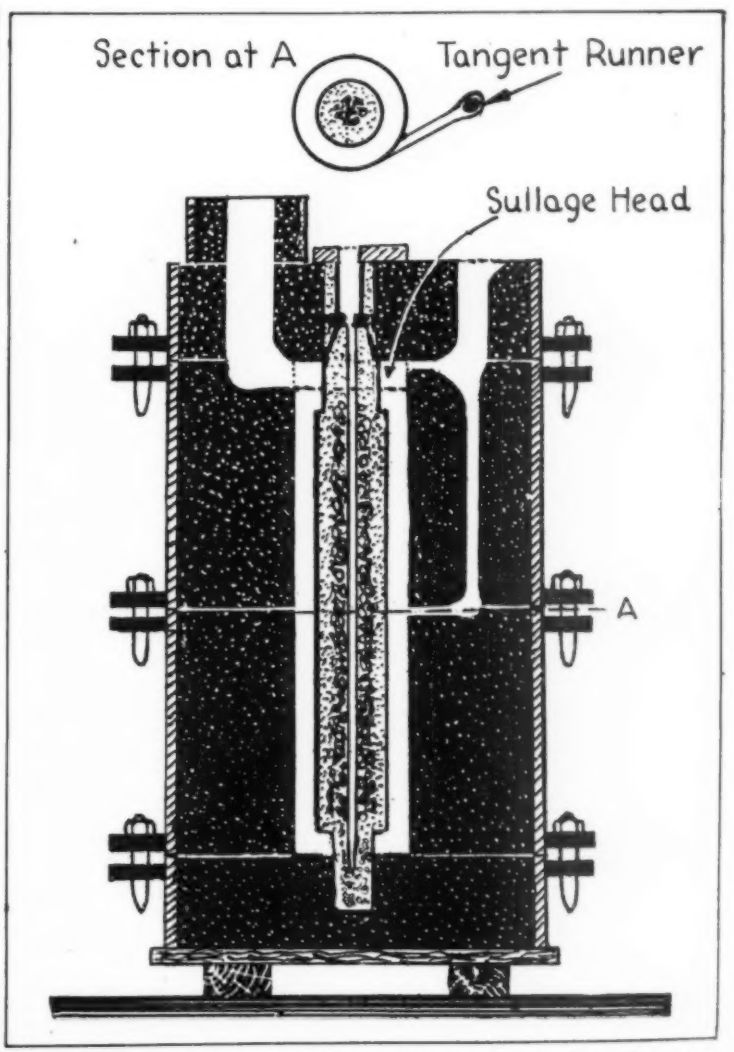


FIG. 1—VERTICAL SECTION THROUGH A MOLD FOR SMALL PLUNGERS FIG. 2—LARGE BRONZE PLUNGER MOLDED AND CAST VERTICALLY

below the joint that when the patterns are stood thereon, the core prints will be entirely in the drag, but the casting itself, entirely in the cheek. The drag is then rammed around the prints, with careful tucking of sand under the bottom edge of the pattern, and a parting is made level with the flask joint. The cheek part is then closed onto the drag and the whole is rammed with the dryer sand, using for the purpose a small rammer consisting of a suitable length of 5/8-inch round iron rod, with a small pean cast on one end. The molding sand for this part is first screened through a No. 6, or No. 8 sieve, and it is rammed quite hard, making sure no soft spots are left between the layers of ramming. When the cheek is filled

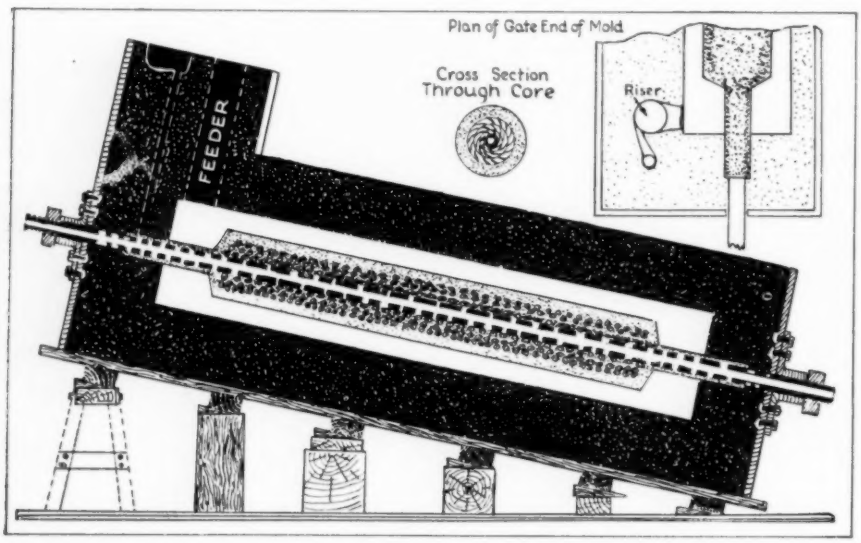


FIG. 3—SECTION OF A MOLD FOR A CALENDER ROLL

a parting is made, and the cope is placed. The cope carries the top coreprints and the sprue. The castings are gated at the top as shown in Fig. 1. The castings are all on one gate which is cut after the patterns have been drawn, as there would be no saving by using a *set gate pattern.*

Small Flasks Used

As the flasks are small, about 6 inches square inside, they are quickly rammed, and the cope lifted and patterns drawn. Usually, the latter are of iron and are loosened in the sand by hitting the coreprints with a mallet. After the patterns have been drawn the cheek is lifted off the drag and is stood on the floor on its three pins, which act as legs, then the cores are stood in the prints in the drag and are set as plumb as possible, then the cheek is closed over the cores onto the drag, after which follows the cope, and the mold is done.

Some molders get so expert on such work they never lift off the cheek, and consequently require no drag parting, the cores being lowered to place through the mold forming the body of the casting. This method saves a little time and is quite safe to follow when the bottom prints are longer than usual and are given a good taper and the corresponding prints on the cores are made to fit perfectly. The vent from the cores is taken off from the bottom of the mold; first the layer of sand under the prints in the drag is pierced with a heavy vent wire, then before removing the vent wire, a hack saw blade is pushed under the lower edge of the drag until it strikes the end of the vent wire, the contact being felt by the hand holding the vent wire. This ensures a passage for the gases from the core to the outer air, and it would also ensure a passage for the molten metal provided the cores are smaller than the prints they fill. For this reason some prefer the little extra labor of the three-part flask, as the green sand can be pressed around the core after it has been stood in its print. As illustrative of the advantages some qualities of molding and core sand give to the fortunate users, such castings as these plungers have been made in thousands in English brass foundries, using for the core a well milled Mansfield sand, and absolutely no vent in the core—none required. Using these ventless cores, owing to the toughness of the sand, made in the round without dryers, it is not necessary to take off a vent from the bottom or from the top. The sand is naturally bonded, and gives off no gas. After the molds are poured, with metal hot, the copes are removed. The cheeks are pounded with hammers to loosen the sand, and then are lifted off the castings. After breaking off the gates the cores are *blown out* by taking the castings singly in long-handled tongs and plunging them into water, immediately giving them a smart rap against the sides of the tank. If the first rap fails to start the reaction, others should follow rapidly.

Should Be Held Horizontal

When blowing out cores from castings, the latter, whether long like these plungers or a gate of globe valves, should be held horizontal and lowered deep into the water, then be rapped smartly against the sides of the container, which, for best results, ought to be a cast-iron tank, fitted with running water, and an overflow, and preferably sunk into the floor of the shop.

When making molds for these plunger castings it is necessary to ram the cheek solidly to avoid swells on the sides as such defects would increase weight, and the machining cost. If the molder is not alive to the necessity of working his sand very dry for the cheek part of the mold, his labors will be in vain until he acquires this knowledge, for the castings will be blown; in fact, it may be impossible to keep the metal in the mold, as it will be ejected with violence from the sprue. All types of brass or gun metal castings, plungers, sleeves, bushings, and even solid castings such as valve stems, when molded by ramming sand around patterns standing vertically, require the sand to be worked dryer than usual. Otherwise the result will be castings defective because of blows, scabs, and porosity after machining. This also may be possible in the case of horizontal molding. And it makes little difference whether the castings are about 4 inches long like the plungers shown in Fig. 1, or 14 or more feet, like paper mill rolls. More difficulty always is experienced by the average molder in getting sound castings, than when the patterns can be molded in a two-part flask and the molds are poured level, on an incline, or are even poured vertical by simply up-ending the mold and pouring through the end of the flask. The reason for this is the difficulty of getting off the vent from the flask rammed vertically. This will be dealt with later.

Molded in Two-Part Flask

Fig. 2 illustrates a larger plunger casting molded and poured vertically. Such castings are not always cast in this manner. Many prefer to mold them in two-part flasks and to pour them on an incline. When so molded there are two ways in which they can be gated. The metal can be run into the casting from the highest end, or it can be pushed through the casting from the lower end and into a riser located on the highest end. These methods have been fully dealt with in an article published in THE FOUNDRY, Sept. 1, 1922.

which method is best is a matter of opinion, and it is not everyone that has success with both ways. For this reason the vertical method of molding is illustrated in Fig. 2, as some may prefer it and get better results than with a horizontal mold. Such a casting will weigh around 300 pounds. In the method shown, the metal is entered into the mold midway of its length, and there is another gate at the top of the casting. The striking feature of this method is that the gate is set at a tangent to the circumference of the casting with the idea of giving the metal a whirling motion as it rises in the mold. These whirl gates do not operate until they strike a body of metal, therefore, the lower part of the mold is filled with still metal. The bottom whirl gate shoots the metal along the curve of the mold wall in a falling arc to the bottom where it splashes and gradually fills the well to the level of the gate entrance; then the whirl effect gets into action. The whirl is supposed to carry any dirt particles to the vicinity of the core then buoy them upward into the upper part of the casting, where there is a sullage head 2 inches deep, as outlined by the dotted lines in Fig. 2. On the side opposite to the pouring sprue, a feeder 3 inches in diameter is located to provide metal to prevent shrinkage in the upper part of the casting. The pouring sprue does not fill up this riser. After the mold is filled sand is put on top of the sprue, then a small weight is bedded thereon to hold in the liquid metal. Then the riser is filled independently, thus getting hot metal to hold the riser liquid as long as possible.

This method of molding plungers, shown in Fig. 2, was followed in one brass foundry with, as was stated, good results. But it would have been more certain to produce perfect castings had another gate been carried to the bottom of the casting to avoid the splashing of metal from the middle cheek to the bottom of the mold, which must have been made of a very loamy, free-venting molding sand to have withstood without cutting away part of the wells even when the mold was blacked and skin-dried.

Made in Halves

The core was made in halves and pasted and wired together, and the inside was well vented with small coke, as shown. It is advisable to give the core two coats of plumbago; one while green and another after it has been pasted together. The joint left after the two halves have been put together has to be solidly filled. If the filling sand is mixed with one part of silicate of soda in three parts of water, and the dried walls of the core are first painted with this solution, a solid, permanent, nonblowing joint will result.

Fig. 3 shows a longitudinal section of a mold to produce a cloth printing roll. This is quite a large casting as bronze castings go, being 6 feet long, and 1 foot 2 inches in diameter. The flask to accomodate it will have to be close to 7 feet 6 inches in length, and 30 inches deep, half of which is cope and half drag. The width of the flask should be ample to allow of space for the riser and sprue which bottom on the mold joint. In the illustration, Fig. 3, the mold is set to be poured from the higher end, but whether this is as good a way as pouring from the lower end and feeding from the higher end, is a debatable point. However, the method shown was actually used and gave good results as a considerable number of such castings were so made without experiencing difficulty. Given a loamy, tough facing sand, well dried, blacked, and permeable to the gases let loose, the method shown will give good results. The mold itself, and the material of which it is made, have such a profound influence upon the results that it is not possible to insist upon one method of locating gates and risers.

The opening at each end of the roll is contracted to a passage about 2½ inches in diameter and 6 inches long. Outside of this is solid metal which forms the bearings on which the roll is rotated. Inside these limits the core is expanded to lighten the casting as much as possible. Thus the core is almost entirely surrounded by metal, and should there be any hesitation on the part of the gases in getting away from the surfaces in contact with the molten metal, an agitation will be set up—a quivering or shivering of the metal—that will result in porosity under the external skin of the casting. This will become visible when the casting is machined. Therefore, the core has to be skillfully made with a view of providing for the instantaneous escape of the gases generated at its circumference and ends. Also, both strength and rigidity are required; the one so that the core will hold together under the severe test imposed by the hot molten metal flowing around it, and the other so that the core will not bend or spring to any appreciable extent under the enormous upward pressure exerted by the metal.

Surface Engraved

The outer diameter of this casting is turned off, and the machined surface is then engraved with the pattern required for printing calico. Therefore, the surface must be free from all blemish. Furthermore, when the engraved pattern is worn out, or becomes obsolete, the roll is again turned off to a smooth surface on which another design is engraved. This is continued until the metal gets too thin for further service. Therefore, it follows that the metal must be sound all through its thickness. Usually this can be figured on when the first surface turned is found to be perfect. Due to this requirement for perfection the roll cannot be made with chaplets placed on top of the core to hold it against springing under the hydrostatic pressure of the metal.

For this reason it is necessary to make the core on a stout, rigid steel arbor. A swept-up core will meet the requirements better than a solid core made with a corebox. A steel tube is used for the arbor. It is 2 inches in diameter with walls ⅜ inch thick. The gases are taken away from the core through this tubular arbor, which is drilled with innumerable quarter-inch holes over the entire length covered with sand. The bare ends of this arbor extend a considerable length through the ends of the flask. The latter being of metal, and well braced longitudinally, has bearings fitted on either end to receive the arbor, and just hold it without play, but does not clamp onto it.

The object of the end bearings on the flask is to make it impossible for the arbor and the core it carries to become displaced, either sideways, upward or downward, but to permit of free endwise movement of the arbor. This is necessary because as the arbor gets heated it expands and lengthens, and if held rigidly by the bearings it would buckle within the mold. To facilitate this endwise movement both bearings and arbor, where they came in contact with each others are rubbed well with plumbago.

Ends Are Threaded

The ends of the arbor outside the bearings are threaded as shown in Fig. 3, and large bronze nuts are run on to just tighten to a bearing against the ends of the bearings. By this arrangement the core arbor is held against any possibility of springing. As the arbor heats up it will lengthen and the nuts will no longer touch the bearings, but by the time this happens the metal within the mold will have proceeded toward solidification far enough to have lost the greater part of its hydrostatic pressure on the core. However, should there be any doubt about this, the nuts can be tightened, once or twice. In doing this care must be exercised not to leave them thus tightened on the expended arbor, otherwise, as it cools and contracts again, something will break.

The pouring end of the mold is raised about 6 inches, as shown. This necessitated the entire length of the mold being solidly blocked to prevent sagging of the bottom board which would mean

a runout and the loss of the casting. Between 2000 and 3000 pounds of metal are required to pour such a mold, and due to this weight, as well as to the inclination, and the high head on the mold the pressure at the lower end will be tremendous. Therefore, this end of the mold must be especially well held together, or secured by clamps, not only of the pinch type, but with long, stout bolts with cross pieces. Also, if a mold of this size can be sunk into the floor until about half the cope only is above ground, it will be much easier to pour and inspire the molders with a feeling of confidence.

Another type of bushing is the ring which may range in size from that of a thimble up to several feet in diameter. The depth or thickness also may vary to as great an extent. The cylindrical form with a depth from 12 to 14 inches and a diameter from 1 foot upward are considered here. Several different methods of gating them will be discussed.

Give Good Results

The easy way which follows the lines of least resistance and requires no thought on the part of the molder is to carry a pouring gate to the joint of the mold, then cut one or more runners from the bottom of the pouring gate to the pattern. Another easy way is to place the sprue on top of the green-sand core that forms the inner boundary of the ring, then cut gates, like the spokes of a wheel radiating from the pouring gate as a hub, into the mold cavity. Sometimes these methods give good results, more particularly with the smaller sizes of rings. But it is doubtful if the larger sizes can be made to turn up clean from green-sand molds because of the danger of cutting away the sand where the metal first strikes. The best method of running them is by a gate on the bottom of the ring. To do this and avoid having to cheek-off the outer circumference, it is necessary to carry the gate by the aid of runner cores which are rammed up with the pattern in the drag of the mold. These cores should *not* be placed so the metal will run into the side of the casting and strike against the green-sand core, because the latter would probably scab in front of the gate. The runner core is made in two parts; one a trough-shaped length, the other a cover for the same. Usually they are rectangular in cross section, and are simply a long, square, dried core with a square hole running down its length. The open ends can be plugged by cementing in a piece of core. The core must be sufficiently long to reach from the pattern to the sprue, and at one end a round hole is bored through to admit the end of the sprue pattern, which latter is exactly as long as the ring is deep. At the opposite end of the runner core another hole is cut through the side, and this is the gate into the casting.

Set Runner Core

When the pattern is put on a follow board and the drag is to be rolled over, before the ramming commences, the runner core is laid with one end on the edge of the ring pattern and the other end resting on the sprue pattern, or gate stick, which is fitted into the hole made for it. Sand is now rammed around the gate stick to hold it in place, then the runner core is removed and the mold is rammed up to the top of the pattern as it lies on the follow board. The runner core is placed across from the pattern to the gate stick and is buried in rammed sand as the drag is finished. After the mold has been rolled over, the cope rammed and lifted off, and the pattern drawn, the gate stick is pulled out leaving a hole through the drag down into the runner core. Thus a pathway is formed into the bottom edge of the ring. Any sand that gets into this runner is easily removed by blowing through it. The down gate through the cope can be set directly on top of the one in the drag, or it can be stepped off to break the fall of metal, as considered best. When a number of such rings have to be made, provided they are of different sizes, they can be molded, one inside the other, and this is frequently done. In this case the runner cores have to be long enough to bridge across the bottoms of all the rings, and must have gates cut through and so spaced that they connect exactly with the edges of all the rings. These runner cores can also be dispensed with entirely, if, when the rings are rammed up flush with the upper edge, a rectangular stick is laid across from the down gate. The ramming then is carried up to the top of the horizontal stick, which is then drawn out and the channel is covered with a dry-sand slab core, then the drag is rammed. This method leaves a channel, having green sand on three sides and dry sand on one side, to carry the metal from the pouring gate into the molds for the rings. This method is not as reliable as the use of all dry-sand runner cores, made of sharp sand bonded with silicate of soda solution.

A ring of large diameter will require to be poured at two diametrically opposite points, using two pots or ladles of metal. Two risers of small size, sometimes called *watch-ups*, should be placed on opposite corners to the sprues to relieve the air pressure and also enable the manner in which the metal rises to be observed and also carry off accumulating gasses from within the mold.

Irregular Chill in Mine Car Wheels

By H. E. Diller

Question—Mine car wheels which we make take a deeper chill at the outer edge of the tread and the chill lightens as it approaches the throat or flange of the wheel. Also, at two sections of the diameter of the wheel the chill is deeper than at the other portions.

Answer—It is evident that the increased depth of chill at the outer edge of the tread is due to the heat being carried away faster at those portions of the wheel. Now this may be caused by having too light a chiller which gets heated by the heavier section of metal near the flange to such an extent that it loses some of its chilling properties. Also it may be due to the casting shrinking away from the chill near the throat or flange. It may also be caused by the way the casting is gated or the speed with which it is poured. The wheel should be poured rapidly. The difference in depth of chill around the circumference of the wheel may be due to the wheel shrinking away from the chiller at certain points or to the metal, as it flows into the mold, striking against portions of the chill and heating it excessively at these points, thus decreasing its chilling properties.

Iron Absorbs Carbon

By H. E. Diller

Question—We accumulate large quantities of pipe ends ranging from 1 to 5 inches in diameter. Could we use this in the cupola to get a soft steel with 0.30 per cent carbon or under? Might this be done using charcoal fuel?

Answer—Pipe ends could not be melted in the cupola either with charcoal or with coke without taking up at least 1 per cent carbon. Even then you would have difficulty in getting the metal hot enough to run, and an excess of fuel would be required. Certainly, you could not melt this stock in the cupola and get a metal with 0.3 per cent or under of carbon gases. Flattening the pieces and using electric furnaces might be economical.

The Codd Tank & Specialty Co., 1155 South street, Baltimore, is seeking a company to manufacture its patented malleable iron pipe unions.

Lee Hall has resigned his position with the Monarch Engineering & Mfg. Co., and has opened offices at 521 Maryland Ave., Baltimore. He will deal in used melting furnaces and will act as general adviser to plants constructing or repairing furnaces. He will also specialize in low-cost conversion of old coke furnaces of the pit type to oil and gas burning.

How and Why in Brass Founding

By Charles Vickers

Formula for Non-arcing Trolley Wheels

What kind of material is used for making trolley wheels; some thing that prevents them from sparking.

The following mixture ordinarily is employed for making trolley wheels:

TROLLEY WHEEL FORMULA

	Pounds
Copper	92.00
Tin	6.00
Zinc	2.00

Lead in a trolley wheel is supposed to favor arcing and some makers imagine that zinc exercises a similar effect and therefore use phosphorus instead of zinc in the foregoing mixture. A non-zinc mixture would be made up as follows:

NON-ZINC TROLLEY FORMULA

	Pounds
Copper	93.50
15 per cent phosphor copper	0.50
Tin	6.00

Either of the mixtures may be used, both are quite suitable and greatly used for trolley wheels.

Reasons for Porosity in Brass Castings

We send for your inspection a small brass casting which has given us considerable trouble lately. You will note it is badly pitted on the cope side. The brass in the casting will analyze about as follows: copper, 78 per cent; zinc 15 per cent; lead 6 per cent, tin 1 per cent. The furnace charge consists mainly of brass ingot to which enough zinc and lead is added to give the required analysis. The metal is melted in an electric furnace of the carbon resistor type at a temperature of about 2300 degrees Fahr, and we do not believe these melting conditions give much chance for oxidation of the metal. The ladles used for pouring the metal are perfectly dry, and the sand apparently is tempered correctly. We have used the electric furnace for years but never have had any trouble like this until recently.

Apparently all the work connected with the production of these castings has proceeded exactly the same as when good results were obtained, but there must have been some change somewhere, otherwise, it is logical to conclude, the same good results would be obtained now as in the past. The casting contains a number of rather large holes on one of the polished surfaces that was horizontally exposed to the cope. One of these is a little larger than a pin head, and originally before being cut open, was globular. We know these holes were produced by a gas which rose to a high point of the casting and struck against the sand surface like the little bubbles that attach themselves to the sides of a glass filled with water. A magnifying glass shows these are not the only holes in the casting. The thin flange cast vertically has its cope side filled with holes, but burred over by the cutting tool. Consequently, as there are many holes there was a considerable amount of gas in that metal when molten. How was this gas produced?

We are beginning to see that oxides themselves will not cause holes in castings, because oxides are solids. They produce dirty castings, but not the holes that are described by the word porosity. When the oxide falls out, of course it leaves a hole, but it will not be a clean more or less globular hole. Therefore, we can ascribe the cavities in this casting to a gaseous body. The fact of the holes being confined practically to one side of the casting would indicate the reaction between oxide and sulphur with production of sulphur dioxide was not the cause, because it has been the experience of the writer that this gas produces a casting aerated in every part, the drag half as well as the cope side. Oxidation then is a doubtful cause of this trouble, and we have left the possible gassing of the metal in the furnace, and the production of gas or steam from the molds.

As regards the furnace, as shown by Wyoski and Boeck, a reducing atmosphere is more dangerous than an oxidizing one, and as there is sound reasoning behind this statement. We suggest that a mineral flux or covering be used in the furnace in place of charcoal, if such has been used, with the idea of reducing the oxides of carbon in the atmosphere of the furnace to get a more oxidizing atmosphere. If the melting is at fault a little study will disclose the fact, and a remedy can be applied easily. In the case of the molds, investigate the amount of sand at the service of the molders. It is important to know if the molders have enough cool sand to fill the molds all the day, or if, at some time a backing of hot sand is being used. The appearance of the sample casting certainly suggests this latter possibility as the cause of the holes. If the sand is the same as before and the molds are rammed the same, then some simple matter like hot sand as the source of the trouble is suggested.

We will leave you to reason out for yourself how a backing of hot sand can produce porous castings. We all know hot sand cannot be used directly on the patterns, as it would stick. Cool sand is used to prevent sticking, then back it with more sand, warm enough to steam, and carefully confine it with a bottom board, and let it stand, then pour in liquid hot metal and imagine the result.

Caution Observed Using an Aluminum Flux

We will greatly appreciate advice concerning zinc chloride; we wonder if zinc chloride in dissolved form is as good for fluxing aluminum as the granular chemical. Also will it lose its effectiveness as a flux if it is permitted to stand exposed to the air?

Zinc chloride is just as effective either mixed with water or in the solid state as far as its fluxing action on aluminum is concerned, but it is more inconvenient in the form of a liquid. It is a dilequescent salt that takes up water from the atmosphere when allowed to stand. Some melters consider the water a nuisance, but unless the chloride is kept from the atmosphere it is only a question of time before it becomes syrupy.

One way of using it while liquid is to mix it with fine sawdust, then place a little in a piece of paper and drop it onto the surface of the aluminum. Charcoal powder or any other inert absorbent would be just as good. Zinc chloride as a flux on aluminum should be used sparingly, no more than is necessary to detach the metal from the dross. Generally all that is done is to use it on the surface of the molten metal. Some melters of scrap aluminum, have schemes for submerging the zinc chloride, but this method is attended with danger should the material contain any water. Molten aluminum is not a thing to trifle with, and experiments in immersing foreign bodies are apt to produce unexpected and disastrous explosions.

The immersion of a skimmer which had stood on a concrete floor, and to

which it is thought some small portion of concrete in some manner had stuck, produced an explosion that threw two hundred pounds of molten aluminum into the air and blinded the melter for life. The sawdust saturated with liquid chloride is perfectly safe if not immersed.

Seeks Light on Several Aluminum Features

We will feel greatly favored if you will kindly answer the following questions. (1) *Can the 99 per cent pure aluminum be kept in a molten condition indefinitely, in the absence of oxygen?* (2) *Can it be remelted to original fluidity in the absence of oxygen?* (3) *Can commercially pure aluminum be alloyed to reduce its melting point substantially below 1000 degrees Fahr.?* (4) *When alloyed, is aluminum less subject to oxidation?* (5) *Please give the composition of several alloys of aluminum of lower melting point than pure aluminum.* (6) *Will these alloys stand in molten condition indefinitely, without decomposition or volatilization in the absence of oxygen?* (7) *Can either pure aluminum or its alloys be melted and kept molten in either an iron or a steel crucible for long periods without alloying with the metal of the crucible?* (8) *Has zinc chloride the property of restoring the fluidity of molten aluminum?*

Aluminum is a very active chemical element and there are few combinations of other elements it will not attack when conditions are favorable. It is merely a question of temperature and in what condition the aluminum is brought into contact with reacting substances. Answering question No. 1: In the absence of oxygen the element cannot form oxides, but if nitrogen is present it will combine with that element to form nitrides, and if carbon also is present this will facilitate the reaction and at the same time carbide also will form. In all melting operations with aluminum, oxide and nitride are formed with usually a small amount of carbide. It would be necessary therefore to exclude all three of these elements with which aluminum combines rather easily, and if the melting vessel is built of material the aluminum will only attack at a very high temperature, or not at all, there is no reason why, as we see it why it cannot be kept molten indefinitely. A suitable material for such a melting vessel would be alumina and the temperature of the aluminum should be kept to the point where the metal is just thinly fluid.

(2) In the absence of oxygen, nitrogen and carbon; yes. (3) No; the eutectic alloy of copper 33 per cent and aluminum 67 per cent, melts at 1004 degrees Fahr., according to Robert J. Anderson. If tin or zinc were used to lower the melting point it would be necessary to use a large amount of these metals and the aluminum might just as well be eliminated entirely.

(4) No. (5) Copper 33 per cent, aluminum 67 per cent, no value as a metal; copper 50 per cent; aluminum 50 per cent; used as hardeners only. Tin 50 per cent, aluminum 50 per cent. (6) Doubtful. (7) Cast iron crucibles are better than pressed steel crucibles and are used extensively; but in time the aluminum will destroy the crucible, therefore, it cannot be kept molten in such containers indefinitely. (8) No; zinc chloride and other chlorides act to cause a separation of the metallic part of the fluid from the nonmetallic or oxidized portion; it is the presence of the nonmetallic substance that decreases the fluidity. Some smelters claim to submerge zinc chloride in the molten aluminum to disentangle the suspended oxide and other nonmetallic combinations, but this operation has to be carried out with skill to avoid disastrous explosions.

If the object in keeping aluminum molten indefinitely is to use it as a hardening bath for steels or other alloys we believe that it would be inferior to the metals and salts now used for that purpose.

Patterns Printed Back for Smooth Skin

We use large quantities of small yellow brass castings and gun metal in the manufacture of locks and builder's hardware. We do not get the fine surface and light golden color obtained by makers in the United States and believe they use an alloy known as Gilding Metal. Can you give us the analysis of an alloy which will produce castings of fine surface, light golden color and which will machine easily?

Gilding metal is too soft for foundry use and is not used for hardware castings. It is a rolling and drawing alloy of the following composition: Copper 90 per cent; zinc 10 per cent, and is known as gilding metal because its color approximates that of 14 karat gold. It is used to make collar buttons; pins, rings, buttons and many other articles that afterward are gilded.

A good yellow alloy suitable for the purpose stated in the query follows: Copper, 75 per cent; zinc 22 per cent; tin 2 per cent; lead 1 per cent. A good clean running alloy for castings resembling gun metal follows: Copper 85 per cent; zinc 9 per cent; tin 3 per cent; lead 3 per cent. A very high grade alloy suitable for the better castings follows: Copper 90 per cent; tin 6.50 per cent; zinc 2 per cent; lead 1.5 per cent.

To secure a fine surface on castings it is necessary to provide patterns finely finished and assembled on plates or gates. The molds have to be faced with a very fine grade of molding sand and the flasks should be iron or aluminum, kept in perfect order. The pins are cleaned after each heat and rubbed with graphite. For very fine castings it may be necessary to *print back* the patterns. After the patterns are removed the face of the mold is sprayed with molasses water or stale beer. Next an even veneer of fine dry sand is dusted on the mold surface through a bag of muslin, calico or linen, so that a very fine powder is spread evenly over the mold surfaces. Excess is blown off with air, then a fine parting such as lycopodium, or substitute is dusted over the face of the mold, the patterns are returned and the mold is rammed with the butt rammer. Afterward the mold is opened, the patterns are removed, the mold is floured, then is skin-dried and finally poured.

When only one, especially fine, surface is desired on a casting that surface is placed in the cope, and the cope is merely lifted, and then printed back. It may be necessary to repeat the printing when exceedingly fine surfaces are wanted. Some foundries dispense with the printing back method by especial attention to the sand that forms the mold facing. It is dried and put through fine screens to get a sand like flour from which the facing is made. In making the molds the facing is worked rather dry so it will pack perfectly smooth.

Copper Tamping Bars

We have some tamping bars to make for coal mine service and they must be made of a mixture of copper and some other metal that will form an alloy that will not spark. We would like to know if tin can be added to stiffen the alloy, or must it be made entirely of copper. If the latter metal, what would be the best way to proceed to get solid castings? We have to case a set screw in one end. Should it be cast on end or sideways?

Copper would be too soft to use for a tamping bar unless it was cast oversize and then forged under a power-driven hammer which would temper it until hard and stiff. The copper can be made to cast sound by the addition of 1 per cent of silicon copper after it is melted. The silicon copper should contain 10 per cent silicon.

Phosphor bronze is frequently used when a non-sparking metal is required. An alloy of copper 87 per cent, phosphor copper 2 per cent, and tin 11 per cent would be satisfactory. The phosphor copper should contain 15 per cent phosphorus.

FORMULA FOR FINDING TAPERS

By Arthur McAlpine

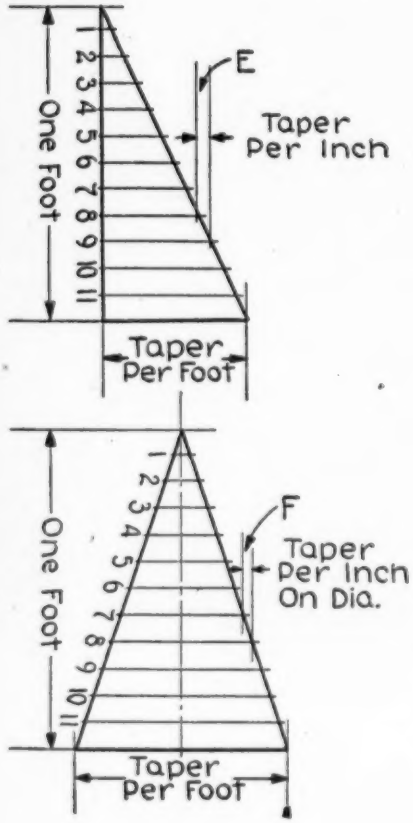


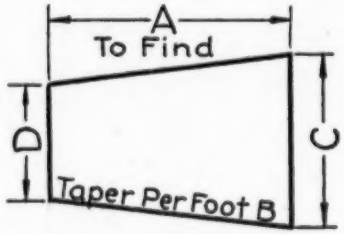
TABLE OF TAPERS

Taper inch per foot	E per inch	F per inch
1/16	0.0052	0.0026
1/8	0.0104	0.0052
3/16	0.0156	0.0078
1/4	0.0208	0.0104
5/16	0.0260	0.0130
3/8	0.0312	0.0156
7/16	0.0364	0.0182
1/2	0.0417	0.0208
9/16	0.0468	0.0234
5/8	0.0521	0.0260
11/16	0.0573	0.0286
3/4	0.0625	0.0312
13/16	0.0677	0.0338
7/8	0.0729	0.0364
1	0.0833	0.0416
1 1/8	0.0937	0.0468
1 1/4	0.1041	0.0521
1 3/8	0.1146	0.0573
1 1/2	0.1250	0.0625
1 5/8	0.1354	0.0677
1 3/4	0.1458	0.0729
1 7/8	0.1562	0.0781
2	0.1667	0.0833
2 1/4	0.1875	0.0937
2 1/2	0.2085	0.1041
2 3/4	0.2291	0.1146
3	0.2500	0.1250

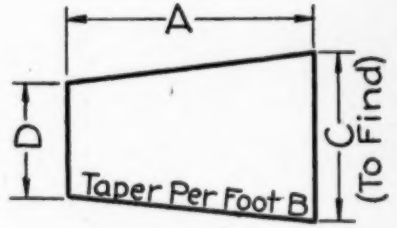
(Concluded on Data Sheet No. 482)

FORMULAS FOR FINDING TAPERS

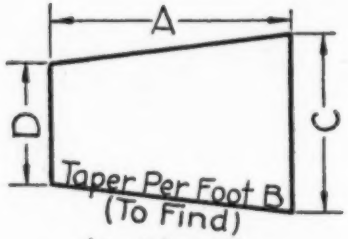
(Concluded from Data Sheet No. 481)



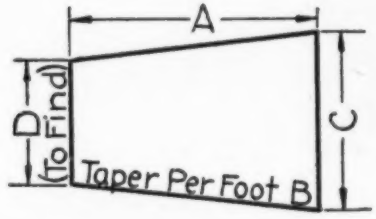
$$A = \frac{(C - D) \times 12}{B}$$



$$C = D + (\text{Taper Per Inch} \times B)$$



$$B = \frac{(C - D) \times 12}{A}$$



$$D = C - (\text{Taper Per Inch} \times B)$$

THE FOUNDRY DATA SHEET, JUNE 15, 1923

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches and may be readily bound in note book form.

ESTABLISHED 1883

THE KNICKERBOCKER COMPANY

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CONTRACTORS EQUIPMENT

AND DUST COLLECTORS

JACKSON, MICH.

W. B. KNICKERBOCKER, PRES.
EDWARD A. BANCKER, VICE PRES.
S. H. HEYWOOD, SECY-TREAS.

May 25, 1923.

THE FOUNDRY,
Penton Bldg.,
Cleveland, Ohio.

Gentlemen:

Of the various mediums in which we advertise our Dust Collectors, THE FOUNDRY has for years given us the largest returns in both inquiries and sales.

Probably this is due to the fact that you reach a field, to meet the requirements of which our Collector was primarily developed. Yet our results could not be so satisfactory did you not cover this field so completely. Were we to curtail our publicity, THE FOUNDRY is the last paper from which we would withdraw our advertising.

We enjoy writing this letter just as we hope it will prove of pleasure to you to receive it and an encouragement for further efforts toward even greater success on your part.

Very truly yours,

THE KNICKERBOCKER COMPANY,

W. B. Knickerbocker

President

WBK:DF

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Foundry Practice in Britain

Metallurgical Features of Ferrous and Nonferrous Metals Are Discussed Briefly and Typical Analyses Are Presented To Show the Effect of Melting and Heat Treating Metals at Varying Temperatures

BY PERCY LONGMUIR

ALTHOUGH prepared under the stress of high pressure this paper has afforded the author considerable pleasure in that it has given him the opportunity of renewing acquaintance with an association whose published transactions contain four of his earlier papers in 1901 and 1902. These early papers offer a natural starting point for the present one which presents a brief review of metallurgical development in British foundry practice. To be strictly accurate the sequence of a review of this character should commence in Egypt about 2000 B. C. and continue to the period showing the development of the bronze age which later merged into the iron age at least a century before the first Roman invasion of Britain. A material development of the iron industry may be traced to the period when the Scandinavian invaders over ran the north of England. Strong evidence of early iron production is present within a short radius of where these notes are written, Wortley, near Sheffield. The evidence indicates that wrought iron was produced and afterward passed through grooved rolls driven by water power.

Following the revival of the coking process introduced by Darby of Dudley, the natural development of blast furnace practice had a corresponding effect on gray iron foundry progress and ultimately on that of steel founding.

Professor Turner's investigation of the effect of silicon on iron, published in the journal of the Chemical society 1885, not only gave a definite impetus to foundry development, but achieved a more important result in that it directed the attention of many other investigators toward a systematic study of cast metals.

Manganese in Its Application to Metallurgy, a comprehensive work by Hadfield, read before the Institution of Civil Engineers Feb. 28, 1888, has led to vast extension in the field of ferrous metallurgy and consequential development in steel foundry practice.

Arnold in his classical research on the influence of carbon on iron, published in 1895 in the journal of the Institution of Civil Engineers, Vol. CXXIII, paved the way for definite studies of constitution which since have been developed and advanced by many workers to the profit of metallurgy in general and foundry science in particular.

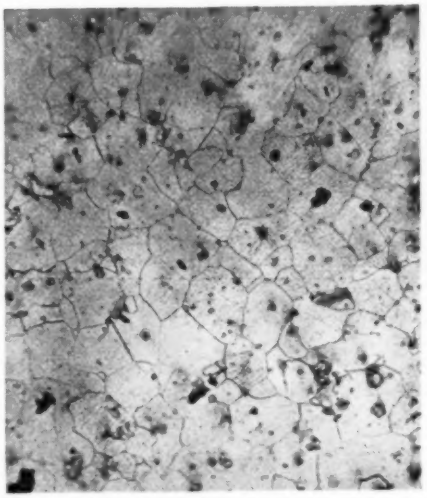


FIG. 2.—MALLEABLE CAST IRON x 100 DIAMETERS

Table I

Method of Melting

	Charge	Crucible	Cupola	Coal-fired Reverberatory	Gas-fired Open-hearth
	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent
Carbon	3.5	3.4	3.4	3.2	3.2
Silicon	0.85	0.82	0.75	0.65	0.70
Manganese	0.20	0.10	0.10	0.10	0.10
Sulphur	0.25	0.30	0.31	0.27	0.26
Phosphorus	0.05	0.05	0.05	0.05	0.05

Indicate Progress

Reports of the Alloys Research committee of the Institution of Mechanical Engineers; proceedings of the Iron & Steel Institute; institution of British Foundrymen; Institute of Metals and many other live organizations contain definite evidence of appreciable forward movement. In addition, British universities are doing particularly good work in pushing the outposts of the known into the unknown. On account of its extent it is impossible to refer to the work in detail; but reference should be made to the valuable efforts of Desch in Sheffield and Turner in Birmingham.

In a paper presented before the convention of the American Foundrymen's association in 1901, the author concluded with the following expressed opinion: "The future of all foundry work de-

Table II

American Malleable Iron Castings Analysis of Hard Iron

Mark	Silicon	Phosphorus	Sulphur	Manganese	Combined Carbon
1	0.76	0.193	0.05	0.20	2.13
2	0.88	0.180	0.051	0.23	2.26
3	0.80	0.190	0.049	0.20	2.37

Physical Tests

Mark	Maximum Stress tons per sq. in.	Elongation % on 2 in.	Reduction of area of
1	26.5	36.7	38.0
2	26.1	35.9	33.2
3	25.8	25.7	30.1

Annual exchange paper from the Institution of British Foundrymen presented before the convention of the American Foundrymen's association in Cleveland, May 1-4, 1923. The author Percy Longmuir D. Met.; M. B. E., is past president of the Institution of British Foundrymen and at present is director of research for the British Cast Iron Research association.

pends upon the development of scientific methods. From the foothold these methods already have obtained we see the dawn of an era which will be distinguished by a great advance in the entire foundry field."

The intervening 22 years have shown that the foothold then indicated has become firmly established and methods based on science have become a factor in all the more important British foundries. Undoubtedly, this is due to the fact that science has progressed hand in hand with practice. Chemical and metallographical laboratories have demonstrated their value to practice and improved practice on the floor and melting platform has re-acted on the laboratories.

There is no denying that united development has taken place but still the fact remains that each forward step simply has increased the extent of the unknown. However, this is characteristic of human endeavor along all lines including that of seeking for knowledge. The breasting of one hill only serves to display vistas of other and higher hills yet to be climbed.

Leeway To Make Up

Engineering practice received a great deal more attention than foundry practice 22 years ago. It has continued to receive at least an equal amount ever since. Therefore the foundry had not only to make up lost time, but in addition had to overtake the present standard in an industry whose foundation depends upon a supply of suitable castings. To what extent these conditions have been met was shown admirably in the paper presented by F. J. Cook before the Rochester convention of the American Foundrymen's association held last year.

Table III

Pure Iron Castings

	Yield Point Tons sq. in.	Maximum Stress Tons per sq. in.	Elongation Per cent on 2 ins.	Reduction of area Per cent	Bending Angle (degrees)
As cast	23.1	35.8	8	9	33
Annealed	17.3	32.1	21	28	180

The British iron founder has a wide choice from which to select his pig iron. This is due to the great variety of iron ores available to the blast furnaces in the country and also to the variation in blast furnace practice in various districts. The choice still further may be supplemented by the addition of steel scrap or ferro alloys in varying proportions and through these various agencies a wide range of product is made possible. A noteworthy indication of the time and study spent on this product is reflected in the proceedings of the Institution of British Foundrymen. The range in composition only is equalled by the range in the types of castings. The development of high speed internal combustion engines has involved the production of exceeding intricate castings and it is gratifying to note how admirably the foundrymen are meeting the demand. Interesting contrast of two extremes is typified by castings made in Falkirk and Sheffield. In Falkirk, Mr. Riddle can take the leaf from a tree and reproduce it in cast iron while down in Sheffield. Mr. T. Firth, Brightside Foundry & Engineering Co., turns out castings of 106 tons similar to that shown in Fig. 1.

FIG. 1.—EXAMPLE OF LARGE INGOT MOLD CASTING WEIGHING 106 TONS MADE AT THE BRIGHTSIDE FOUNDRY & ENGINEERING WORKS, SHEFFIELD

Cupola Is Efficient

Advantages and disadvantages of the cupola as an iron melting medium were pointed out in the exchange paper presented before the Institution of British Foundrymen by G. K. Elliott in 1921. However so long as cost remains the ruling factor, supplemented by the fact that the cupola usually is so efficient, the adoption of the duplex electric furnace process is not likely to receive any appreciable measure of consideration. In discussing this paper Desch indicated that the natural economic avenue for the electric furnace is in the direction of steel castings.

Research work in Great Britain now is going forward with a view of increasing cupola efficiency and at the

Table IV

Nickel Steels in the Cast Condition Reheated to and Cooled from 800 Degrees Cent.

Contents of Nickel	Contents of Carbon	Contents of Manganese	Yield Point tons per sq. in.	Maximum Stress tons per sq. in.	Elongation Per cent on 1.75 ins.	Reduction of are a Per cent
Nil	0.47	0.95	19.24	38.49	51.42	16.26
1.20	0.48	0.79	22.07	43.23	14.28	14.88
2.15	0.47	0.86	25.79	42.84	17.70	23.51
4.25	0.40	0.82	28.11	43.49	13.10	17.94
4.95	0.42	1.03	36.00	56.09	14.28	24.43
6.42	0.52	0.92	37.13	57.51	6.20	8.42
7.95	0.43	0.79	41.47	74.03	4.50	5.68
12.22	0.41	0.85	39.85	71.19	6.20	6.88
15.98	0.45	0.83	31.59	76.55	4.00	4.21
19.91	0.41	0.96	17.94	29.69	14.30	19.05

same time an intensive study is being made of the possibilities of open hearth furnaces fired either with coal, oil or gas. Future economic development of gray iron melting processes will be along one of the foregoing lines.

Malleable Cast Iron

So far as quantity is concerned *white heart* takes precedence over *black heart* malleable iron in British foundries. White, semimottled and mottled pig iron are available and many furnaces also supply refined pig iron. Refining of the bath is permissable where an open-hearth gas fired furnace is the melting medium. Crucible melting is followed to a considerable extent especially in the Midlands, but the great bulk of malleable castings are made from cupola melted metal. Coal fired reverberatory and gas fired open-hearth furnaces also are employed to some extent and the development of the industry seems to point to the growing popularity of the latter type. Representative melting practice is shown in Table 1.

Average commercial castings show an ultimate strength of from 20 to 28 tons (44,800 to 62,720 pounds); an elongation of from 2 to 6 per cent in 2 inches a reduction in area of from 2 to 8 per cent. Cold bending tests on ½-inch square bars range from 45 to 90 degrees. Commercial castings of Scottish origin tested by the author showed the following results: Silicon, 0.65 per cent; manganese, 0.15 per cent; sulphur, 0.30 per cent; phosphorus, 0.04 per cent; ultimate strength, 27 tons (60.480 pounds) elongation, 5.7 per cent in 2 inches; reduction in area, 10 per cent.

Contrasts American Practice

Indication of the valuable pioneering work done by Hadfield is contained in the journal of the Iron and Steel Institute for 1906 and also in a more recent contribution, *Cast Iron in the Light of Recent Research.* Reference also should be made to some promising work done by Royson, an account of which appeared in the journal of the Iron and Steel Institute for 1897. Apparently Royson's efforts were directed toward obtaining a quick if not instantaneous decomposition of the hard carbides and thereby shorten the annealing time. Today, this subject is well worthy of investigation with particular reference to determining critical ranges in the near vicinity of the solidification range.

A certain amount of laboratory experimental work has been done along this line. In 1904 the author obtained this quick decomposition and resultant precipitation of temper carbon by heating castings to temperatures near the fusion point. However, investigation under practical operating conditions is hindered by foundry conditions, influence of mass, change in section and contour of casting; factors that introduce many variables.

Table V

Properties of Metals as Cast

Metal	Maximum Stress, Tons per sq. in.	Elongation Per cent on 2 ins.	Specific Gravity
Copper	8.1	9.2	8.8
Zinc	1.5	....	7.15
Tin	2.0	30.0	7.29
Lead	1.5	36.0	11.35
Nickel	16.2	4.5	8.84
Aluminum	5.1	5.3	2.65

Interesting contrast to the foregoing is presented in Table I of the paper read before the Institution of British Foundrymen last year by Enrique Touceda, consulting engineer, American Malleable Iron association. The table is shown as Table II.

British malleable cast iron practice presents a promising field for research and the author echos and appreciates Touceda's sentiments touching on cooperation between the two countries.

Ductility of a casting recently selected at random in a British foundry was so evident under a striking hammer that analyses and metallographical examinations were made with the following results:

Total carbon	0.03 per cent
Graphitic carbon	Nil
Silicon	0.52 per cent
Manganese	0.17 per cent
Sulphur	0.292 per cent
Phosphorus	0.049 per cent

Microscopical examination showed structure to be built up mainly of ferrite with involved iron and manganese sulphides. A typical field is shown in Fig. 2 and in the absence of sulphides this is structurally equal to the purest Swedish wrought iron.

Systematic steel casting in foundries began in Britain about 1856 and Vickers was one of the first successful practitioners. He was followed by many other workers along the same line including Attwood, Rogerson, Spencer and Osborn. The exhibit of the Terre Noire Co., at the Paris exhibition, 1878 apparently gave an impetus to the steel casting industry. In the early days development naturally was along trial lines and errors were the rule rather than the exception. The foundation of the steel casting industry was laid in the patient, persistent work of this period.

Practical trial and experiment followed by the researches of Hadfield, Stead, Arnold, McWilliam and many others not only opened up scientific possibilities, but led to further united practical and scientific attack on the problems connected with the successful production of steel castings.

Melting Process Varied

In present day commercial practice the crucible process only is followed to a limited extent. The great bulk of steel for castings is melted either by the open hearth or converter process. The electric furnace is gaining ground in the steel foundry field. Through elasticity in method of operation it presents an excellent medium for the production of special and alloy steel castings.

In a general manner it may be stated that the first concern of the metallurgist is to determine the most suitable composition to meet definite required mechanical obligations. The second requirement is to see that the steel, whether melted in an open-hearth, converter or electric furnace is in the condition known

Table VI

Properties of Alloys

Alloy	Copper	Zinc	Tin	Maximum Stress Tons per sq. in.	Elongation Per cent on 2 ins.
Red brass	90.0	10.0	....	12.6	26.0
Yellow brass	70.0	30.0	....	13.0	43.0
Muntz metal	60.0	40.0	....	19.0	15.0
Gun metal	88.0	2.0	10.0	18.0	11.0
Gun metal	86.0	4.0	10.0	17.0	10.5
Gun metal	87.0	5.0	8.0	15.0	9.0

Table VII

Results of Detailed Investigation

Metal	Casting Temperature Degrees Cent.	Maximum Stress Tons per Sq. In.	Elongation Per cent on 2 Ins.
Zinc	580	1.30	....
	528	1.81	....
	491	1.37	....
Aluminum	725	4.48	2.5
	691	5.62	8.5
	662	5.12	5.0
Copper	1500	6.60	8.5
	1446	7.80	11.0
	1141	8.80	8.0
Lead	580	1.13	18.0
	430	1.43	35.0
	360	1.30	42.0

GRAY CAST IRON

C C	Gr.	Si	Mn	S.	P	Casting temperature Degrees Cent.	Maximum Stress Tons per Sq. In.
0.52	3.4	1.78	0.28	0.04	0.27	1400	9.7
						1350	14.1
						1245	10.6

MALLEABLE CAST IRON

Casting temperature degrees Cent.	As Cast maximum stress tons per sq. in.	Annealed maximum stress tons per sq. in.	Heated to 1000 degrees Cent. slowly cooled
1320	10.7	20.6	18.6
1230	15.9	29.2	24.0
1120	12.1	26.5	21.6

ANNEALED STEEL CASTINGS

C	Si	Mn	S	P	Casting temperature	Maximum stress tons per sq. in.	Elongation per cent on 2 ins.
0.29	0.07	0.16	0.07	0.06	High	24.2	9.5
					Fair	27.2	24.0
					Medium	27.0	12.5
					Low	25.5	8.0

ALLOYS

Alloy	Casting temperature	Maximum stress tons per sq. in.	Elongation per cent on 2 ins.
Gun metal	High	8.38	5.5
	Fair	14.84	14.5
	Low	11.02	5.0
Yellow brass	High	11.48	37.7
	Fair	12.71	43.0
	Low	7.45	15.0
Red brass	High	6.85	13.2
	Fair	12.65	26.0
	Low	5.67	5.5
Muntz metal	High	12.45	6.0
	Fair	18.89	15.0
	Low	16.29	9.5

as *killed* before it is poured. Judicious conduct of the process and judicious use of deoxidizers will bring about metal of this character. A pure iron casting showing silicon 0.02 per cent; carbon, 0.04 per cent; manganese 0.07 per cent; sulphur 0.02 per cent and phosphorus 0.02 per cent; was crucible melted, killed with a trace of aluminum and yielded the following figures under test. The upper line represents the casting as cast; the lower line as annealed.

Yield Point Tons	Max Stress Tons	Elongation Per cent 2 inch	Reduction area Per cent
10.7	19.8	30	39
9.1	19.2	46	65

This degree of purity is not a commercial necessity and simply is presented to illustrate the properties of pure iron in a treated and untreated condition. Gradually increased addition of carbon to iron will stiffen it proportionally, but experience has shown that carbon alone is not sufficient, at least so far as castings are concerned. For this reason, silicon and manganese—the two usual deoxidizing agents—are added singly or combined in sufficient quantity to leave a predetermined excess in the finished steel.

A steel casting of the following analyses: carbon, 0.34 per cent; silicon, 0.15 per cent; manganese, 1.58 per cent; sulphur, 0.06 per cent and phosphorus, 0.06 per cent showed the physical characteristics presented in Table III.

Influence of special elements covers a wide field and the results shown in Table IV represent only a comparatively small section of the field. It deals with nickel steels in the cast condition reheated to and cooled from 800 degrees Cent. The table is taken from figures compiled by Carpenter, Hadfield and Longmuir and is incorporated in the seventh report submitted to the Alloys Research committee on Iron, Nickel, Manganese and Carbon alloys.

Nonferrous Foundry Practice

Accurate analyses are particularly necessary in nonferrous foundry practice and the cost is justified on account of the comparatively high intrinsic value of the constituent metals. In British practice metal is melted in coke fired crucible furnaces, coal fired reverberatory furnaces and in various types of gas and oil fired furnaces. The constituent metals vary in density and other physical properties. Typical results obtained from commercially pure metals, sand cast and in an untreated condition are shown in Table V.

The results shown amply illustrate the value of alloying. Alloys may be produced in infinite variety and in actual practice are produced in nearly every possible combination.

Two important points are particularly worthy of consideration in connection with this subject. 1. On an economic basis, scrap, including borings and turnings should be graded into strict classifications. 2. Inevitable loss through volitilization should be provided for before the metal is melted. This point is of special importance while working with high tension brass, based on 60 per cent copper and 40 per cent zinc. Irrespective of the presence of any third metal it is imperative that an excess of zinc be used in the charge to compensate for melting loss.

Typical physical properties of commercially sand cast alloys are shown in Table VI.

Many features are common to all types

and grades of castings. Liquid shrinkage, solid contraction and resultant warping are familiar features. The degree varies in intensity with the metal or alloy. It is impossible within the limits of this paper to touch on all these interesting features but there is one common characteristic demanding a few moment's attention. That is the manner in which the physical properties of metals are influenced by varying casting temperatures.

Some years ago, hard practical experience in the production of high pressure fittings, led to the discovery that for a given metal or alloy, pressure resisting castings were produced so long as the metal was poured within a definite range of temperatures. Castings poured from the same metal but at a different temperature inevitably produced porous castings. Detailed investigation on this subject resulted in the compilation of the figures shown in Table VII.

The results shown in this table are selected from an extended series and in each instance represent the contents of one crucible or one ladle. In the method adopted the metal or alloy first was super heated and while in this condition one set of test bars was poured. This is designated as *high*. The metal then was allowed to cool in the ladle until it had arrived at the temperature designated as *fair*. At this point a second set of bars was poured. The third set was poured when the metal had cooled to the lowest safe pouring temperature. On the table this is shown as *low*.

The physical results given show within the contents of one crucible a wide range of properties due to variation in casting temperature. An equally wide range will be noted if a number of valve bodies are cast from the contents of one crucible under similar conditions. The castings corresponding to the *fair* heat will be tight when subjected to internal pressure. Castings poured from metal on either side of the *fair* zone will show porosity.

Although many actual casting temperatures have been determined only comparatively few have been quoted in degrees Cent. This, of course, is due to the fact that it is impossible to arbitrarily set a constant *fair* casting temperature for any given alloy that will apply to every type of casting poured from that alloy. Correct casting temperature necessarily must vary with the contour, surface area and sectional thickness of the casting. On these points, trained foundry skill and judgment can be employed to the advantage of the product.

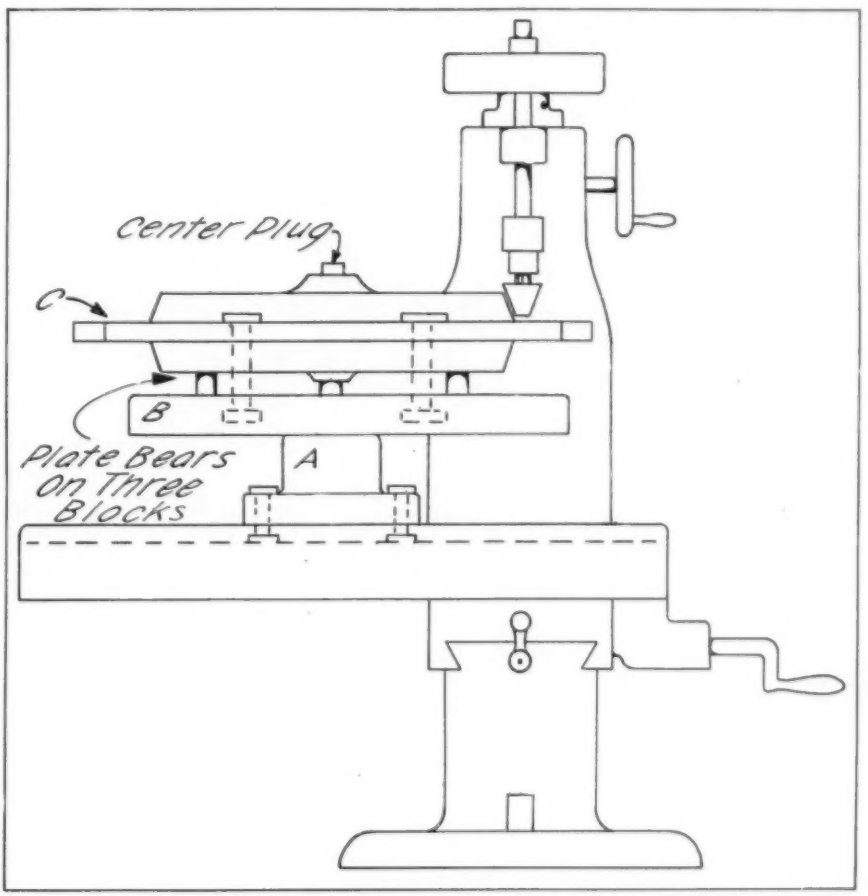
The Farrel Foundry & Machine Co. has awarded a contract to the Immick Co., Meridian, Conn., for two additions to its local plant.

Pattern Finished on a Milling Machine

By C. G. Spicer

Several aluminum pattern plates with a half pulley pattern on each side were sent into the pattern shop to be finished and then it was discovered that on account of the two lugs the patterns were too wide to swing on the face plate of the lathe. Since it was necessary to machine the hub and the outside and inside of the rim, we had to devise some other method to handle the job. A vertical miller was available and although it was not equipped with a revolving table it was adapted in a manner that proved quite satisfactory. A cast-iron block *A*, machined top and bottom and provided in the center with a hole to receive the shank of a drill press table *B*, was bolted to the table of the milling machine. A 1-inch steel plug set into a hole in the center of the drill press table and projecting about 3 inches above the surface served to locate the pattern *C*, by a hole drilled through the center for that purpose. Three holes were drilled between the pattern arms by which to bolt the pattern to the drill press table. These holes afterward were countersunk on both sides and filled with babbitt. Cutters were made from pieces of 5/8-steel, forged to the required shape, hardened and sharpened.

The table was adjusted until the cutter touched the rim of the pattern on the outside and in a straight line with the center and then the machine was started. Grasping the pattern by the lugs with both hands the operator slowly fed it by hand in the opposite direction to that in which the cutter was revolving. The inside of the rim and the hub were finished in a similar manner and then the pattern was turned upside down and the process repeated.



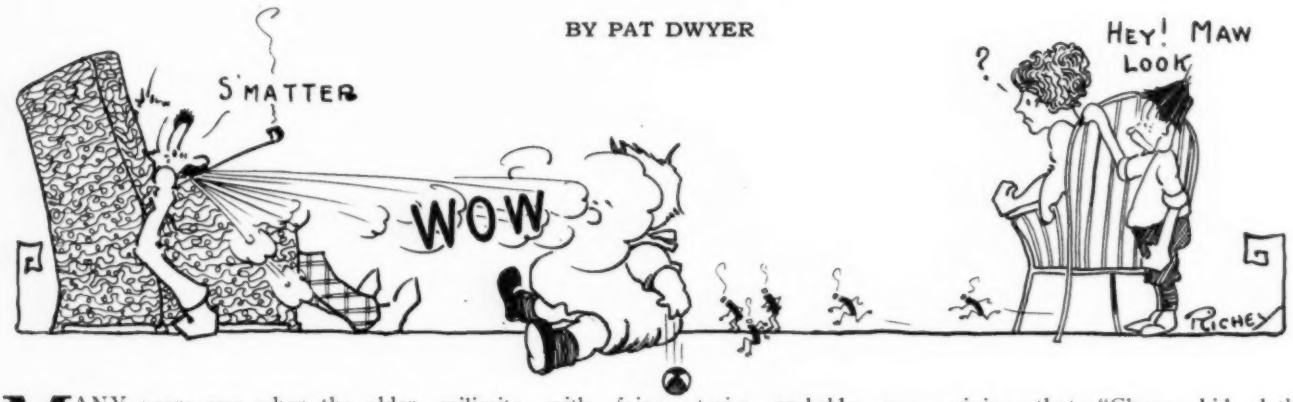
THE DRILL PRESS TABLE SUPPORTING THE PATTERN WAS MOUNTED ON A BASE BLOCK ATTACHED TO THE TABLE OF A MILLING MACHINE AND WAS REVOLVED BY HAND

Thompson & James, manufacturer's sales agents, with offices at 656 Leader-News building, Cleveland, have been appointed exclusive sales agents in Northern Ohio for the Blackwood Electric Steel Corp., Parkersburgh, W. Va. This company specializes in the manufacture of high grade electric steel castings in a new plant recently completed and now in production.

The Royer Foundry & Machine Co., Kingston Station, Wilkes-Barre, Pa., has changed the location of its plant which now is at 158 Pringle street, the same city.

Bill Has A Word On Cupola Practice--V

BY PAT DWYER



MANY years ago when the older children were small enough to sit on my knee without even the formality of an invitation, I spent an hour or two every night engaged in the pleasant occupation of telling stories. I retained a fairly vivid impression of a long list of fairy stories my mother had told me under somewhat similar circumstances and since I had no conscientious scruples in improvising when necessary or when memory failed, I experienced no particular difficulty in holding their attention until the time came when they had to toddle off their little nests.

Occasionally the eyes of the littlest ones closed prematurely and the little limbs relaxed as they entered the land of Nod thus automatically bringing the session to a close. In competition with the old sand man I never scored more than second best. When this happened I was left undecided whether to feel flattered at the insistence of the wakeful members that I continue or to feel thankful at having a legitimate excuse to rest from my labors.

The performance had its pleasant features, but it also presented certain disadvantages. I experienced the greatest difficulty in keeping my pipe going and my audience made no effort to conceal its impatience when I struck another match. I envy those individuals who can talk and smoke at one and the same time. Somehow I have failed to acquire the necessary skill, although heaven knows it has not been for lack of effort or application. The childrens' mother showed a singular lack of appreciation for my friendly efforts to keep the children quiet at night. She did not object to the idea of entertaining the little cherubs. She admitted that a reasonable degree of familiarity with fairy stories probably would do them no harm, but she claimed that the manner in which the stories were related and the smoky conditions under which the children were forced to listen, were highly detrimental morally, mentally and physically. Can you beat it? A prophet in his own and all that kind of thing you know.

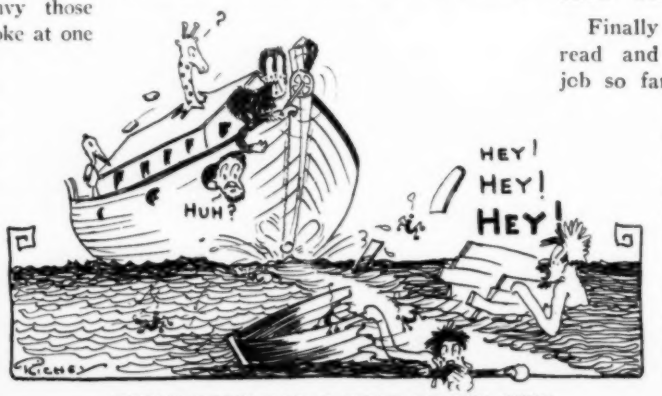
She intimated that if I were to confine myself strictly to the original text, no person reasonably could object, although personally she considered all that kind of thing a species of moonshine and nonsense. In fact she has characterized fiction, both juvenile and adult as so much piffle. Of course this is a strong statement and in strict justice I must admit that she only employs language of that character in private conference.

She was particularly opposed to the manner in which I chose to render the old fairy tales into modern, idiotmatic English. She claimed that I was ruining their young, tender and impressionable minds by filling them full of a species of the King's English that should *not* be spoken. Of course, I put up no argument. Even in those early days I had begun to acquire the rudiments of wisdom. However, I felt then—and I have seen or heard nothing since to cause me to change my opinion—that "C'mon kid, let's beat it," is a more expressive phrase to put into the mouth of the hero than the conventional "My love, let us fly together."

Fly, forsooth! The first phrase applies to a masterful young lad, as Sam Weller would say "full of wim, wigor and witality," ready and willing to have and to hold his lady love against the world. The second conjures up in the mind's eye a pair of little downie birdies that in all probability would be gobbled up by the first marauding chicken hawk cruising in their vicinity.

Some of these stories date back to the time of the flood and perhaps further, since there is a tradition to the effect that the ancestors of Brian Boru had a boat of their own on that historic occasion and were not beholden hand or foot to any person. However, that is no reason why the stories should be told in the original Gaelic language. I could add many reasons to prove my contention to the effect that the stories should be modernized, at least in so far as the language is concerned, but what's the use? The party of the second part either would not listen, or she purposely would misconstrue some of my statements and then pretend to prove that I did not know what I was talking about.

Finally the children learned to read and I found myself out of a job so far as telling them stories was concerned. However, as a result of one of the great laws of nature, sometimes, I believe, referred to as the *law of compensation*, I learned that if I was relieved of responsibility on one count I had to assume it on another. The youngsters developed such a passion for reading that I had to leave my pipe and book every



BRIAN BORU HAD A BOAT OF HIS OWN

night in answer to an S.O.S| call from their mother to drive them off to bed.

Within the past few years, or in fact since they arrived at high school age, I occasionally have suggested the titles of worth while books, but while they were going through the grammar grades I allowed nature to take its course, commencing with Anderson's fairy tales and progressing gradually through Horatio Alger Jr.; Frank Merriwell; Buffalo Bill and Jesse James. While going through these stages I noted one peculiar feature that possibly may interest those well meaning, but practically useless people who spend their lives and—usually—other peoples' money in extended investigations into childrens' mentality. Those masterpieces of fiction undoubtedly were written for boy readers, they are essentially masculine in tone and treatment, love interest rarely is introduced and then only in the most incidental, casual manner and yet the girls were—if possible—more keenly interested than the boys. This feature was even more marked when they arrived at the blood and thunder stage typified by the long list of stories dealing with the life and adventures of the late Mr. James.

I did not examine any of these precious pieces of literature minutely. I did not need to do so since I had read the same kind of stuff at a somewhat similar age, but I gathered in a general way that those in which the most blood was spilled, easily led in popularity.

The noted buffalo hunter, scout and frontiersman has gone to the happy hunting grounds; many a moon has waxed and waned since his trusty Colt *crack, cracked* and made serious inroads on the available supply of painted red skins; it is notoriously true that the buffalo herds never have been the same since Bill's time, but so long as Col. Prentiss Ingraham's trusty typewriter continues to function our hero will occupy niche *A* No. 1 in youth's hall of fame.

Niche No. 2 is reserved for Jesse. Not the Kansas-Missouri desperado and ex-member of Quantrell's guerrilas, but the bold and gallant hero who robbed the rich and helped the poor, the devoted son, the innocent victim of circumstances, the clever and resourceful lad whose exploits with his famous horse Sirocco left Tom Fagus and Winnie his beautiful strawberry mare completely in the shade. The fact that winsome Winnie picked her dainty way through the pages of Lorna Doone long before Jesse's time might lead the adult reader to suspect plagiarism on the part of Mr. James' biographer. That contention automatically falls to the ground for the simple reason that no adult reader—and by adult of course is meant one who is adult in mind—never bothers to read a Jesse James story, while on the other hand it is equally true that no juvenile reader would appreciate Lorna Doone.

OUT IN THE WEST WHERE MEN ARE MEN

Bill came over the other night to return a book he had borrowed some few days previously and having delivered himself of a free and frank opinion of that book in particular he launched out in a panegyric of the good old Beadle Boy's Library and other contemporaneous literature of that period. I politely told him he was talking through his hat. It is 30 years or more since he has seen one of these books and I am sure if he happened to find one of the ancient copies now, he would consider the material nothing but the purest kind of drivel.

"Well," said Bill, "You may be right. I am not prepared to set up an argument on that point, but I am quite certain they are not as drivelly as some of the stuff that passes for literature in this present day and generation. I don't know whether the writers or the readers are the more to blame. However, I suppose it is more logical to place the blame on the readers. If readers did not buy the stuff, publishers would cease printing it. The fact of the matter is that printed material is dumped in front of the reading public in such quantities that reading is becoming a lost art. We skip through the head lines, read part of a paragraph here and there and then throw the book or paper away. Literary excellence? Forget it.

"The objection that applies to newspapers and—shall we say other forms of fiction also applies to technical literature. For example consider the subject of cupola operation. This subject has been the theme for hundreds, perhaps thousands of writers and yet you can walk into any foundry in the country and you can't find one man out of ten who ever has read a word on the subject. The other nine may have had several opportunities to read something concerning the process, but they never bothered and as a result if the cupola man

INITIAL STEPS OF AN INTERPRETIVE AND CHARACTERISTIC DANCE INHERITED FROM KICKAPOO INDIAN ANCESTORS

died or quit tomorrow, they would find themselves up queer street with their eyes blindfolded. They don't know whether iron melts below, at, or above the tuyeres. They have no idea whether the daubing is put on to a thickness of 1 inch or 6 inches and they know as much about *tapping her out* as they do about *stopping her up*—and that's nothing.

"The coke bed should extend about 36 inches above the tuyeres. When starting a new cupola or experimenting with an old one which has not given satisfactory service this point can be marked with chalk before the cupola is charged. Then a ¼-inch rod is bent in the form of a capital Z with one toe resting on the sill of the charging door and the other corresponding with the chalk mark. A sufficient quantity of wood is placed on the sand bed properly to ignite the coke.

"Where an oil burner is employed to start the coke it has been found advantageous to provide a second hole through the lining and shell at the back of the cupola at the level of the sand bed and opposite the tap hole. This second hole supplies a draft at the bottom of the coke bed and insures that the coke bed will burn up level. After the coke is ignited properly this hole is bricked and daubed with mud. The breast is made up at the same time.

"The amount of coke required to form the bed is calculated roughly and approximately half the amount is placed in the cupola before the fire is lighted. After this coke has burned through and settled down in the space formerly occupied by the wood, the remainder of the coke is added up to the point indicated by the bent rod. The first charge of iron then is placed in the cupola, followed by alternate charges of coke and iron until the cupola is filled to the charging door. The wind then is put on and charging is continued until a sufficient amount of iron has been placed in the cupola to pour all the molds comprising the day's work.

"The coke is weighed and measured on the first day and once a standard has been established it can be measured on subsequent days with a fair degree of accuracy.

"Perhaps the most deeply intrenched among the 57 misconceptions in the average cupola tender's articles of faith is the belief that it is necessary to leave the tap hole open after the wind goes on and until varying amounts of iron, depending on the size of the cupola, have been allowed to run over the spout into a shallow basin on the floor. The claim is advanced that this procedure is necessary to heat the tap hole and also that the first iron melted is not fit to pour into castings.

"Between 5 and 10 minutes after the wind goes on, depending on the height of the bed ,and the length of time the cupola has been standing with the fire burning, a shower of sparks comes flying out through the tap hole. The cupola tender stands on a raised platform to one side of the spout in case he is attending a large cupola or directly in front if he is attending a small one, until the iron runs freely from the spout. When, in his judgment, a sufficient quantity has run through, he closes the tap hole and allows the iron to accumulate on the inside. Afterward he taps the cupola at more or less regular intervals; but becomes quite indignant if he is asked to let the iron run after the well is empty and the blast commences to blow a shower of sparks through the tap hole.

"All the mess incident to practice of this character is unnecessary and there is no need of the cupola tender constantly appearing like a hardy perrenial clothed in garments that would be refused indigantly by the old colthes man. While it is true that the first iron melted usually is a little hard, due to the fact that the lower silicon iron melts first, that is not a sufficient reason for wasting it by allowing it to run into a pig bed under the spout. The iron should be kept in the cupola until the entire first charge has melted and then it will be found that the first iron tapped is perfectly satisfactory.

"To insure a clean, hot tap hole for the first iron, the breast is made up in the usual manner and the tap hole is left open until just before the wind is put on. A core, usually 1 inch in diameter and from 4 to 6 inches in length is inserted in the tap hole and daubed lightly with clay on the outer end to prevent the iron leaking past. The wind then is put on and by watching through the peep holes in the tuyeres it is a comparatively simple matter to decide when a sufficient quantity of iron is melted and ready to tap. Where melting conditions are uniform from day to day the period may be timed so accurately that it becomes unnecessary to watch the tuyeres, the iron may be tapped on a time schedule. While it is preferable to have a cupola tender competent to judge conditions for himself, it is not always possible to have a man of that kind on the job and on these occasions it is well to have a system so simple in character that it will fit in with the scope of the most untrained and limited intelligence.

"Another commendable feature about the foregoing method of stopping the tap hole just before the wind goes on, is that frequently the cupola man has many little details requiring attention at the last minute and if he has to stand by the spout for perhaps 20 minutes, first before the iron appears and then watching the tuyeres until it is time to tap, he cannot give these details his proper attention. Molten iron must be handled rapidly with a minimum of confusion and in a manner to prevent accidents and for that reason it is necessary to have everything moving smoothly and be as nearly as automatic as possible.

"Before leaving this subject I should like to say a few words about the many methods employed for charging the cupola."

"You may go ahead and say them," I said, "but you are not going to say them to me. If you want to hold my attention, dear lad, you will have to come down off the charging platform."

"Beware! Me proud bee-auty," said Bill. "Never yet has Jack Dangerfield failed to accomplish his desire. You may escape my clutches temporarily, but mark my words, I'll get you yet!"

Cast Large German Bell

What is claimed to be the largest serviceable bell in the world recently has been cast at Apolda near Weimar in Germany to replace the bell taken from the great cathedral in Cologne during the war. The original known as the *Kaiser Bell* was cast in 1874 from French cannon captured in the Franco-Prussian war. It weighed nearly 30 tons and was taken down and remelted into munitions of war during the recent world conflict. The new bell has been formally baptized *St. Peter*, but it is popularly referred to as the *German Bell on the Rhine*. It is nearly 11 feet high, 11 feet in diameter and weighs more than 27 tons. Antique and religious figures and numerous inscriptions decorate the exterior surface of the bell around the upper part. The bell was made by one Master Heinrich Ulrich from a composition of copper 78 parts and tin 22 parts.

The Gibb Instrument Co., Bay City, Mich., has been appointed distributor of its arc welding electrodes by the General Electric Co., in the Middle West.

The North American Mfg., Co., Cleveland, has established a branch office at 53 W. Jackson boulevard, Chicago. Benjamin Sklovsky is district representative.

Double Face Aluminum Plates

Advantages of Using the Method for Increasing Production Outlined Supplemented by a Description of How the Foundryman May Mold and Cast the Plates in His Own Shop

BY JAMES HINES

MATCH plates have been in use in the foundry for many years by men who realized their advantage and present day competition rapidly is forcing their adoption on foundrymen who have been content to rely on the usual follow board or loose pattern methods. Until comparatively recently an impression seemed to prevail to the effect that only patterns of a certain definite shape could be plated. Today a conservative estimate would indicate that 90 per cent of all castings made in iron, brass, steel or aluminum weighing from 1 to 50 pounds can be made successfully from plated patterns. In addition the plated pattern will produce castings more uniform in weight and size than those made in the ordinary manner. Instances are on record where the foundryman has been enabled to cut his price 3 cents a mold on snap flask work without reducing his molders' pay. In other instances it has been found possible to double the number of patterns in a given mold without increasing the area of the flask more than one or two inches either way. For example one manufacturer who has been making a hat and coat hook for over 18 years recently plated his patterns and doubled his production. Formerly he employed a brass gate with 12 pieces in a 10 x 16-inch flask. The plated pattern with 24 patterns goes into a flask 12 x 16 inches. Another company makes castings for pipe pliers. The finished article is sold for 10 cents in the 5 and 10 cent stores and naturally the margin of foundry profit is small. The patterns were plated with the result that now the manufacturer is getting 20 pieces to a mold instead of 12 and at a reduced cost of 2½ cents per mold for labor.

The gates and individual patterns may be arranged to better advantage on a plate than in any other manner. The patterns may be grouped closer and the gates are not so heavy. Where the patterns simply are attached to a gate they invariably work loose after a short time due to hand rapping. Then they must be taken out of the sand and re-gated at a considerable expense and loss of time. Where a match plate is employed, the patterns, gates and plate are in one piece and may be vibrated in a manner that does not injure the assemblage and also insure a uniformity of product.

The author is connected with the Hines Pattern Mfg. Co., Cleveland.

Selecting the Equipment

Discretion should be exercised in preparing a pattern plate to secure maximum service and a little study may assist one in arranging the patterns in a manner that will insure a greater production with possibly a slight increase in flask size. The style of pattern adopted, plated or otherwise will depend on the relative number of castings required. Under ordinary circumstances and on orders for 1000 to 10,000 castings, a match plate is the most satisfactory form of pattern device. However, it has its limitations and where immense quantities of duplicate castings are on order continuously special adaptations may be applied.

Sometimes a foundryman is willing to admit the superiority of a match plate over his present pattern outfit but hesitates to adopt the method under the mistaken impression that he will have to furnish a whole new set of patterns from which to prepare the plate. In the majority of cases the existing patterns will serve satisfactorily. On many small parts the trifling shrinkage involved does not affect the usefulness of the casting and the same consideration applies to many larger castings. The aluminum plate will contract 5/32-inch to the foot and in cases where the contraction feature is a definite factor it will be necessary to prepare a master pattern in which allowance is made for two contractions, one in the pattern plate and the other in the final casting.

Many details must be watched closely in the preparation of a satisfactory match plate free from shifts and excessive shrinkage at the point where the pattern joins the plate and presenting a smooth skin that will require a minimum amount of cleaning before it is placed in production.

The foundryman desiring to make his own match plates will require at least two suitable flasks, cope and drag for each one made of metal, iron steel or aluminum, machined true and parallel on the joint side and provided with four pins of which at least three are hardened. Corresponding hardened bushings are fitted in the cope to prevent the slightest shift. The pins are arranged in such a manner that all four flask parts are interchangeable.

A flask 28 x 38 inches with a 6-inch cope and drag probably is the most convenient size for the average foundry. The finest grade of sand must be employed to produce a smooth and satisfactory skin on the casting. This sand should correspond approximately to No. 00 Albany and even in localities where sand of this character is available, it has been found advantageous to add from one-third to one-half Albany sand to the facing mixture.

Regular No. 12 aluminum in ingot form should be melted to cast the master pattern or patterns. These pattrens are finished nearly and accurately and provided with about twice the usual draft allowance. Only a skilled molder of wide experience, lots of patience and a good eye should be entrusted with the making of the master patterns and plate.

He sets the master pattern up on a sand match or a machined plate and blocks it in position. The method depends on the general characteristics of the required plate. If a plate is employed, the cope flask is set on first and rammed full of sand to form a sand match. It is rolled over, the plate is removed and a temporary parting made. A drag flask then is rammed and the two parts are clamped and rolled over after which the false cope is removed and shaken out. The final parting is made with as much attention to detail as any other part of the mold. It is powdered heavily and brushed with a fine camels hair brush, then blown off clean and covered with a light coating of parting compound. The cope is set on, gate pins arranged and the cope rammed full of sand and lifted off. The surface of the pattern

is covered with sand sifted through a fine screen and both cope and drag are rammed hard and uniformly.

Two men lift the cope slowly and evenly while a third man vibrates the mold by placing a stick about 3 inches wide under the bottom board. The stick is about 18 inches long and is provided with a cleat that serves as a fulcrum. By rapping on the free end of the stick the vibration is transferred to the bottom board. No attempt should be made to patch the face of the cope. If it does not lift perfectly clean it should be shaken out match plate cleaned and the mold rammed again.

The size of the required plate is laid out on the drag parting and then a number of strips either of wood or metal, the exact thickness of the plate are laid on the joint. One row of strips is laid on the planed joint of the flask and the other row is laid on the sand so that the outer edge coincides with the boundary line of the plate. The space between the two rows of strips is filled with sand, pressed down firmly and then scraped off flush. The inner row of strips then is removed, the gates cut and the pattern drawn. Cores or chills are placed at the necessary points to equalize shrinkage and contraction in the heavy sections and particularly where light and heavy sections join. The face of the mold is sprayed with molasses water and skin dried after which the mold is closed and poured as soon thereafter as possible. The mold is poured two-up and with the metal as cold as possible. Cold metal does not shrink to the same extent as hot metal and also it makes smpother castings, which are less likely to show pits when machined.

Corebox Construction Is Simplified

BY M. E. DUGGAN

UNLESS a patternmaker has a working knowledge of molding and coremaking practice he frequently will devote more time and expense to a pattern than is necessary and in addition the finished pattern or corebox may involve extra work in the foundry. In learning the trade the apprentice usually is instructed how to put the various pieces together, but only rarely is he told why the pattern or corebox is constructed in a certain manner. Frequent contact with the foundryman is necessary if the young mechanic aspires to become a pattern maker and not simply a woodworker. While serving as an apprentice I learned to make slab coreboxes in the manner shown in Figs. 1 and 2 with the end pieces checked into the side pieces. The side pieces were gage marked, rough cut with the band saw and finished with the chisel exactly to the line and square. I was instructed to make the ends a tight fit at the corners *A* and *B*. They were fastened with glue and nails and further strengthened by corner pieces as shown. The corners *C* and *D* were made a neat slip fit so that the coremaker would experience no trouble in removing the two parts of the box from the finished core. Sometimes a loose bottom was attached to the slab corebox by dowel pins. All slab coreboxes were made in the same manner irrespective of whether one or one hundred cores were required. Afterward in the foundry I learned that a corebox similar to that shown in Fig. 1, cut from a plain plank, dressed to the required thickness and cut to shape on the band saw will produce a core quite as acceptable as that made in the more elaborate box. One or a dozen cores may

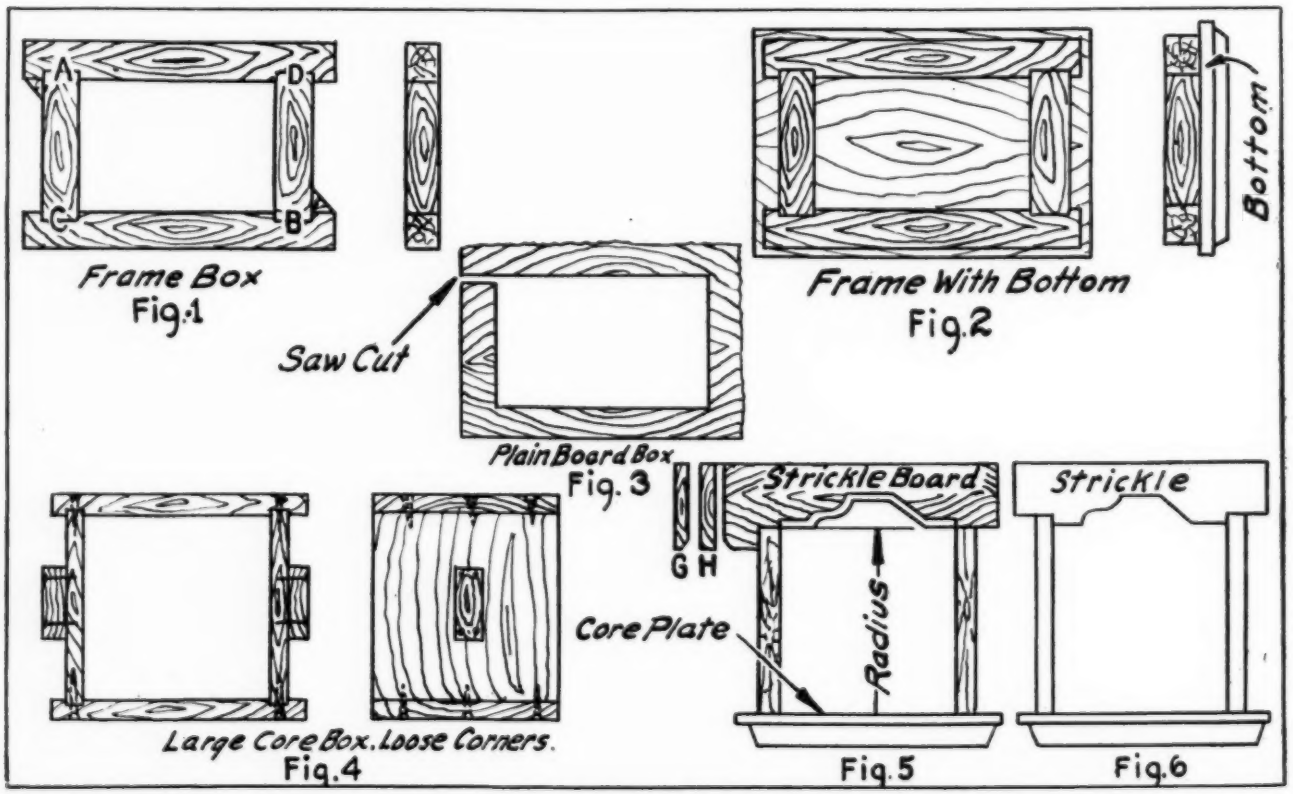


FIG. 1—SLAB COREBOX JOINED AT OPPOSITE CORNERS FIG. 2—SAME BOX WITH BOTTOM ATTACHED FIG. 3—SLAB BOX MADE ON BAND SAW FROM SINGLE PLANK FIG. 4—DEEP COREBOX WITH TWO LOOSE AND TWO TIGHT CORNERS FIGS. 5 AND 6—ALTERNATIVE METHODS OF GUIDING STRIKE BOARDS

be made from this box. Even should the ends break through the end grain of the wood the coremaker can fasten the parts together temporarily with little sharp dogs.

Frames of slab coreboxes should be made as narrow as possible because the cores are made directly on the core plate. Surplus sand must be brushed away and sometimes the core must be pushed close to the preceding core after the corebox is removed. Circumstances will decide whether or not it is advisable to attach a bottom to a slab corebox. The corebox with a bottom may be filled and rammed on the bench and all surplus sand removed before it is taken and rolled onto the drying plate. The open box is rammed directly on the plate. An additional reason in favor of providing a bottom is that the bottom strengthens the box and assists in withstanding the rough usage in the foundry.

Frequently the coremaker can cut and shape a core from slab cores carried in stock and where he cannot secure a core of the correct thickness, he pastes two or more thicknesses together. Of course this seems like shifting the work of the pattern shop to the foundry, but it must be remembered that a pattern and corebox simply are means to an end and any saving of time in either department means a saving in the total time required on any given job.

Another type of plain corebox on which in many cases unnecessary time is spent is shown in Fig. 4. Assuming that the box measures 10 x 10 x 12 inches, the patternmaker probably will make it after the style shown in Fig. 1 with the sides recessed and two corners fastened together solidly and the opposite diagonal corners left loose. He will insert wood screws in all four corners and paint a black circle around the screw heads in the loose corners to indicate to the coremaker that the screws are to be withdrawn before the corebox is removed from the core. In many instances the foregoing method of construction is unnecessary. The box may be built as a unit and lifted straight up from the core.

A section of a struck-off half circular core is shown in Figs. 5 and 6. Many patternmakers bevel the edge of the strickle board and provide a guide on the outside end of the board as shown at *G* and *H*, Fig. 5. Coremakers, as a rule, prefer a square face on the board and a guide on the inside as shown in Fig. 6. The square edge may be employed for packing sand.

Rigging an Intricate Crankcase Core

BY EDWARD H. TINGLEY

At one time considerable trouble was experienced in molding a cast iron crank case on account of the manner in which the collar core rocked while the mold was filling with metal. Several rather complicated cores were required to form an L-shaped projection on one side of the casting. The two principal cores, the body core and collar core are shown in Fig. 1. An investigation disclosed that the cores warped slightly in baking and when assembled in the mold the circular parts did not coincide accurately. The cores were filed and adjusted to a certain extent, but this treatment did not completely solve the problem. Finally the following method was tried and adopted and has resulted in completely curing all the trouble due to core shifts.

The collar core first was made and baked as usual. Then the body core was turned out on a plate and the collar core was slipped over the top into place. A jig shown in Fig. 2 was employed to locate the collar core in its proper relative position on the body core. The jig was dropped over the two cores and the locating stops automatically set the cores. The jig then was removed and the two cores baked as a unit. This method removed any possible chance of the collar core being out of line or rocking and insured an even distribution of metal. It also saved the expense of fitting the dried cores to each other. After the cores were baked they were placed in the jig shown in Fig. 3 and rubbed down to an accurate bearing surface. They afterward were pasted in the usual manner. Jointing the cores in this manner insured round ends of accurate diameter and climinated one of the prolific causes of rejections in the machine shop, shifted plunger openings.

Statistics recently compiled by the department of commerce for the years 1919-1921, indicate that the combined output of all establishments engaged in the manufacture of aluminum products was approximately 50 per cent of the maximum capacity.

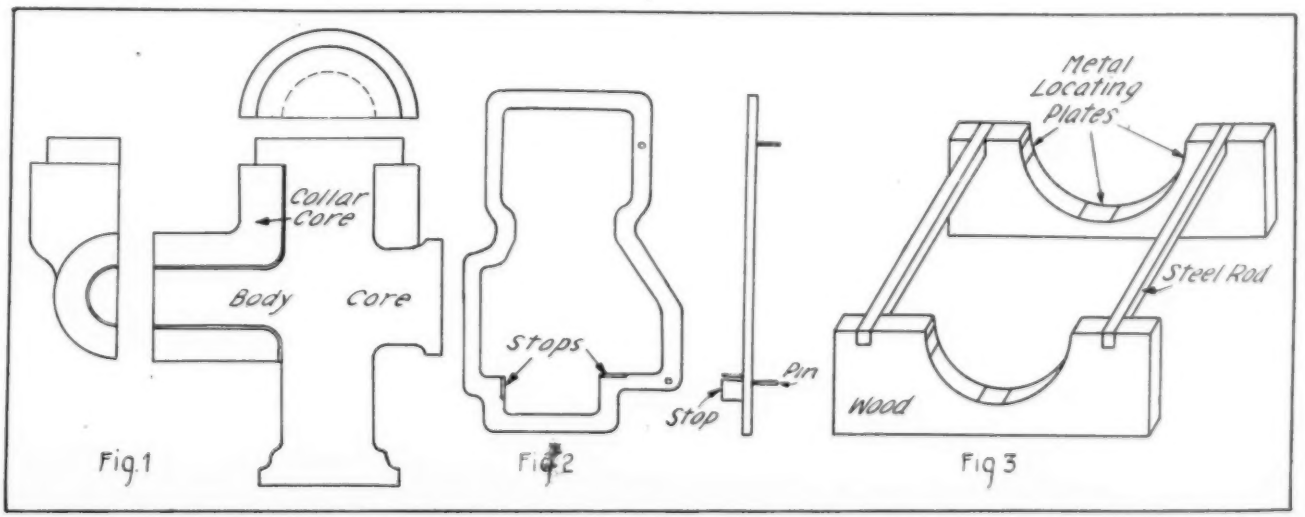


FIG. 1—PLAN AND END VIEWS OF THE BODY AND COLLAR CORES FIG. 2—JIG EMPLOYED FOR ASSEMBLING THE TWO CORES FIG. 3—JIG IN WHICH THE CORE WAS RUBBED DOWN TO A BEARING

Core Cuts When Gates Are Not Set Straight

Question: I have been making packing rings for 18 months without any trouble but recently they have been scabbing in front of the gates. The rings, 36 and 24 inches in diameter and 25 inches deep are made in dry sand molds, two in a flask, one inside the other. The outside of the mold is checked off and the inside is lifted out on a plate to provide an opportunity of applying the backing. The patterns are 14 inches deep and I have to draw them up to a height of 25 inches. The drag contains a heavy cinder bed and after I have rammed the patterns to the full 14 inches I vent down to the cylinders with a ¼-inch wire. I place a covering of cinders over the vent holes and after each ramming as the pattern is drawn I vent to the cinders. I should appreciate your opinion on whether my practice is faulty or is the trouble due to the sand. The molds are popped on top.

Answer: Judging your case from the information submitted, we see no reason why the cores should scab. In fact with all the precautions you have observed we should not hesitate to cast the mold in green sand and produce good castings. One possible cause of your trouble might lie in your runners. You state that the runner box is set on so that the metal falls free to the bottom. Are you sure? If the runners are set slightly at an angle or if the bottoms of the holes are reamed out, or if the holes are too large, the metal will spread on leaving the hole and impinge on the face and sides of the mold.

You say that the mold is scabbed and we are wondering if you mean that it is *cut*. Many molders use the terms indiscriminately in spite of the fact that a scab is caused by the steam forcing a piece of sand off the face of the mold or core and a cut is caused by the stream of metal washing away a portion of the sand.

We feel that you must have made a mistake in indicating the relative amount of different sands in your facing. Either that or your terms differ from ours. According to your statement you used 4 parts sharp sand, 2 red sand, 8 old black sharp sand and 3 river sand. Sharp sand in the usually accepted sense means sand without a bond, sea sand, river sand, core sand therefore your mixture would mean to us 4 parts core sand, 2 parts molding sand, 8 parts old core sand and 3 parts core sand. In our opinion that mixture would sag and might even fall on the face 25 inches high that you note.

Without a knowledge of the kind of sand you have in your shop it would be impossible to suggest a suitable mixture. Where a considerable amount of dry sand work is done it pays to secure a suitable natural sand that does not require any doctoring. In the East a sand known as Lumberton is used extensively for light and medium weight castings while Millville gravel is employed for heavy work in dry sand loam. This sand is used in the natural state and for many jobs can be used satisfactorily in the proportion of half and half new and old sand.

Ordinary molding sand if it is not too fine or if it does not contain too much clay can be adapted for dry sand work by adding varying proportions of sharp sand, that is the sand usually employed for making small cores. For the packing rings we would suggest a mixture of half and half old and new molding sand with a shovel full of sharp sand for every 10 of molding sand. To this could be added if necessary a shovelful of flour or dry core binder to every 20 shovels of sand the whole wet down with thin clay wash.

In making the mold the cinder bed might be omitted in the drag and all the vent taken off through the top. There is no advantage in trying to force the vent down through the bottom when natural channel can be provided at the top. The only vent that needs to be taken care of is that generated in the body of sand between the two rings.

Set the drag down level, ram it full of sand, scrape it off flush with the joint, slick the face, set on the two ring patterns and adjust the lifting plate in the center. Then set the cheek on the outside and place a 12-inch bushing or a small ring pattern of some kind in the center. Set a number of 1-inch rods, pipes or round sticks about 30 inches long about 6 inches apart in the center of the space between the two ring patterns all around. When these are drawn out later they will leave all the vent holes that are required and there will be no need of using a vent wire. Place 4 drawgates 2 x ¾ inches spaced at equal intervals and connecting the two rings near the bottom. These will serve to correct any irregularity in filling the mold and will insure that the iron in both rings will maintain an equal level while the mold is filling.

The mold is rammed up to the joint in the usual manner and then the vent rods are drawn out. The bushing or ring pattern, as the case may be, is drawn up at each successive ramming and the space below filled with cinders or coke. If the mold is to be poured open the sand is banked up around the holes a little higher than the top edge of the mold. If the

cope is to be rammed on the job the joint is slicked off flush, the holes covered over with pieces of paper or cardboard, the gate pins, vent sticks and risers set and the cope filled with sand and rammed.

After the cope has been lifted off a gate cutter is employed to cut a shallow channel connecting the tops of all the vent holes in the ring core. Then the patterns are taken out of the mold after which the center core is lifted out and finally the cheek is lifted off. After pulling out the four draw-gates at the bottom the mold is blacked and placed in the oven to dry. It is optional whether the cheek, drag and core are assembled green and allowed to dry as a unit or are dried separately. As a general rule the latter method is preferable and should be followed.

Warm Blast Conserves Cupola Heat

BY HUBERT HERMANNS

ALTHOUGH the heat efficiency of the ordinary foundry cupola generally is considered to be greater than that of almost any other melting furnace, it cannot be said that the heat value of the coke, or other fuel, is utilized to full advantage. In practice, is has been demonstrated that about 60 per cent of the theoretical heat of the fuel is wasted and part of this loss is due the cold blast employed. Owing to intermittent operation, which prevents the adoption of ordinary regenerative stoves such as are applied to blast furnaces, hot blast has not been applied successfully to cupolas up to the present time. However, a method of preheating the blast for ordinary cupolas recently has been developed in Germany. It presents certain features of interest and is said to have effected economies in coke consumption.

The device works on the hot blast stove or regenerator principle. One form of the apparatus, designed by Alfred Hornig, Dresden, is shown in section in Fig. 1, while a different type of installation, but working on the same principle is shown in the illustration taken from an actual photograph Fig. 2. In the first instance the blast enters at the top of the regenerating chamber and travels down and in the second instance the blast enters the regenerative chamber from the bottom at the back and travels up. The following description covers the type of installation shown in Fig. 1.

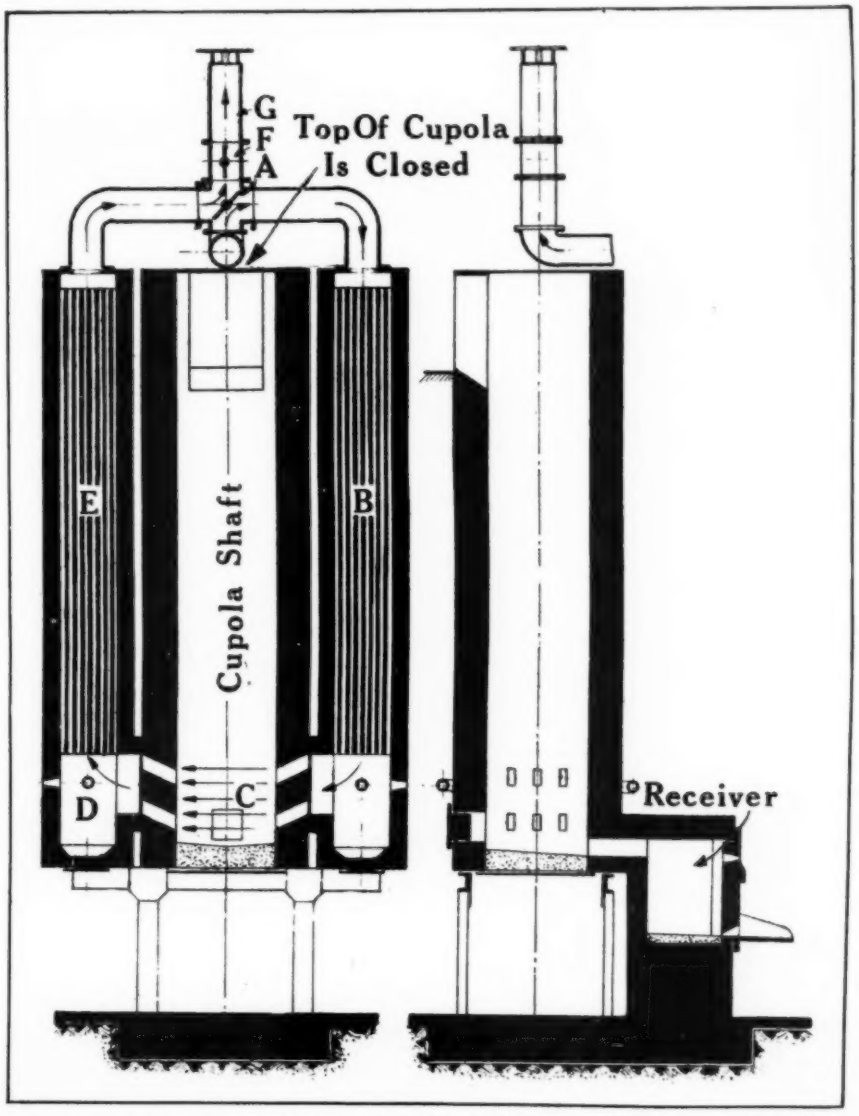


FIG. 1—GASES ARE RECONDUCTED DOWNWARD THROUGH THE TUYERES

FIG. 2—DIFFERENT TYPE OF WARM BLAST CUPOLA EMPLOYING THE SAME PRINCIPLE

It will be noted that the stoves or heaters are set up on both sides of the cupola. The cold blast enters one section *B* through the butterfly valve *A* at the top. Passing through the heater the air is preheated to 650 to 850 degrees Cent. The wind traverses the zone of fusion *C* horizontally on account of the top of the cupola being closed. In the fusion zone the warm blast comes in contact with the incandescent coke and combines with the carbon to form carbon dioxide gas. Passing through the antechamber *D* the waste gases at a temperature of 1400 to 1700 degrees Cent. ascend through the second section of the heater *E* where the heat is extracted. The cooled waste

(Concluded on Page 513)

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Make Castings Appreciated

A LARGE public service corporation with branches in a number of towns through the Middle West has an interesting procedure in buying castings. It uses a great many jobbing castings in its street railway, light and power lines. When in the market, a number of bright young men, using the phones, get in touch with various foundries, inquire casually about the price of the parts sought, express some demur at the rate per pound quoted and manage to inject into the mind of the foundryman whom they have called, some doubt as to the justice of the price asked. These young men know little about the castings they are buying and they care less. They get the best quotations possible, compare them, and let the contract. It may be remarked that the same foundry seldom cares to quote on the work a second time. Of course, this means of buying may prove satisfactory for the corporation in question, but when business is good, as at present, the shop which previously has made castings under these conditions hesitates to accept an order at any price.

Any buyer is privileged to compare prices. This is not questioned. The injustice arises through the evident contempt in which prices on foundry products are held. Perhaps this in turn accrues to the fundryman himself, who too often fails to appraise the fruit of his labor to its full value. When one buys a pair of shoes, an article offered for $6 a pair will not be accepted without question in preference to one costing $12. The buyer usually inquires the reason for the difference in price, or failing to do so, the salesman usually takes the question for granted and tells why the one costs more than the other.

Of course, the buyer of castings, as a rule, may be expected to know the quality of the castings he desires, and the reputation of the foundry making the work enters into the transaction where a repeat order is concerned. But, in cases where buying is delegated to persons not familiar with what to expect, innocent of any knowledge of the processes entailed in producing the castings desired, some time could be profitably spent in education work.

Explain to the prospective buyer the details of producing castings, from the steps in pattern making to the final grinding and sand blasting. Direct attention to the care necessary in buying the right grades of iron, the chemical control incident to preparing the melt, the close supervision in operating the furnace, the skill required in making the cores, mixing the sand for the molds, molding, pouring and finally the care and inspection which follow through the cleaning operations in removing irregularities and finishing the casting until it meets the buyers requirements. Too often we hold in contempt those things which come to us in the bulk, and high speed repetition work has brought castings into the class of material which is sold almost universally by the pound or ton. Some plumbing, ornamental lighting, and jobbing stove castings are notable examples of foundry products now commonly sold on the piece basis. A better appreciation of castings, as a manufactured product, would be fostered in many other cases by quoting and selling them more widely by the unit or piece basis.

Trade Outlook in the Foundry Industry

CAUTION, untinged by apprehension, characterizes the general condition in the castings manufacturing industry. Foundries are busy. In fact, the majority of them are engaged to the limit of their available labor supply upon orders at hand. However, long time contracts are not sought by consumers of castings, and only a few classes of foundries are engaged far in advance of their immediate capacity. This is taken by many to indicate a healthful condition. It proves conclusively that frantic, ill-advised buying and pyramiding of orders is entirely absent in the castings market.

Buy With Care

The same condition characterizes the purchasing of foundries, themselves. Few have placed contracts for iron running into the second half year and only a small number are covered on coke. With an eye to the tremendous production of iron, few feel justified in rushing into the market as long as deliveries continue good and materials may be had quickly on spot shipment. The phenomenal production of pig iron still continues according to statistics compiled by the *Iron Trade Review*. During the month of May, the highest record yet established was made by the blast furnaces, with a total output of 3,866,386 gross tons. This was over 300,000 tons ahead of the April high record of 3,546,308 tons. On a daily average basis, the production for the past month was at the rate of 124,722 tons per day compared with 118,210 tons per day for April. In May the total of the merchant iron production was 906,200 tons as compared with 795,558 tons for the previous month. On the daily average basis, the May output was 29,233 tons as compared to 26,518 tons, giving an increase of 2715 tons per day of this class of iron. The total number of merchant stacks in blast on May 31 was 105, an increase of 13 over the last day of April.

Prices of Raw Material for Foundry Use

CORRECTED TO JUNE 8

Iron		Scrap	
No. 2 Foundry, Valley	28.50 to 29.00	Heavy melting steel, Valley.	22.00
No. 2 Southern, Birmingham	27.00	Heavy melting steel, Pitts.	21.00 to 21.50
No. 2 Foundry, Chicago	32.00 to 33.00	Heavy melting steel, Chicago	18.50 to 19.00
No. 2 Foundry, Philadelphia	29.76 to 30.13	Stove plate, Chicago	18.00 to 18.50
No. 2 Foundry, Buffalo	29.00 to 29.50	No. 1 cast, Chicago	25.25 to 25.75
Basic, Valley	27.50	No. 1 cast, Philadelphia	23.00 to 24.00
Basic, Buffalo	29.50	No. 1 cast, Birmingham	23.00 to 24.00
Malleable, Chicago	32.00 to 33.00	No. 1 cast, Buffalo	22.00 to 23.00
Malleable, Buffalo	30.00	Car wheels, iron, Pittsburgh	23.50 to 24.00
Coke		Car wheels, iron, Chicago	22.50 to 23.00
Connellsville foundry, coke	5.50 to 6.50	Railroad malleable, Chicago	25.00 to 25.50
Wise county foundry, coke.	8.00 to 8.50	Agricultural mal., Chicago	23.50 to 24.00
		Malleable, Buffalo	24.00 to 25.00

Enlarge Facilities

For the first time since the depression of 1920, foundries again are expanding their manufacturing facilities. In some instances this movement is indicated only by the purchase of new equipment to make better use of their present capacity, while in others new additions are being built. Labor shortage is considerably discussed, and in some cases is limiting operations to probably 65 per cent of the possible maximum. Stove manufacturers are experiencing an unusual demand for the season of the year at hand and are suffering through labor shortage. In automotive lines, the rate of operation continues practically unchanged. Some complaint is prevalent due to the inability of automotive foundries to secure patterns as quickly as desired. This is particularly true in the Detroit district. Cast iron pipe producers are confident of continued demand through the fall, as municipal buying again is prevalent. Farm implement dealers report a shortage, while the production of farm machinery is at the rate of from 60 to 80 per cent of normal. Some concern is expressed regarding the effect of higher prices which are expected in implement lines.

Railroad Stressed

Despite the unusual demands made upon the railway lines, shipments continue to be good. During the week of May 26, freight loading totaled 1,014,029 cars, a record which has been reached only twice previously. This was accomplished also, with the surplus cars more than balancing the shortages reported. The unusual shipments of commodities reflect the general conditions throughout the country and also serve as an indication of the better state of the railroads. R. H. Aishten, president of the American Railway association stated recently that from Jan. 1, 1922 to May 1, 1923, the railroads purchased 252,257 new freight cars, of which number, 136,501 had been delivered up to the latter date. During the same period, a total of 4463 locomotives had been ordered and of this total 2607 had been placed in service. Car buying has declined during May. In that month, a total of 3200 freight cars were placed, against 9800 in April and 42,499 in March. This does not indicate a slackening in demand so much as a lack of manufacturing capacity. Some foundries doing railway car work, have orders on their books running through the entire summer and fall. Automobile foundries still are active, but in this case, orders are not placed far in advance. Only a slight decrease has been noted in sales of passenger cars while trucks and tractors maintain about the same level of activity. The peak of automobile demand in the larger cities has passed for this year, but it is expected that agricultural districts will buy more freely.

Brass Shops Active

Demand for plumbing brass goods continues strong, particularly since dealers have been unable to accumulate any stocks. Aluminum foundries are more active than they have been, due to the continued increasing demand from automotive sources and also from the electrical manufacturing lines. Prices for nonferrous metals, accordng to New York quotations in the *Daily Metal Trade* of June 8, follow: Casting copper, 14.62½c; electrolytic copper, 15.00c; Straits tin, 42.37½c; lead, 7.25c to 7.30c; antimony, 6.80c; aluminum, No. 12 alloy, open market, 23.00c to 23.50c. Zinc is 6.30c, E. St. Louis, Ill. Monthly average prices for May, follow:

(New York Quotations)

Castings Copper	Electrolytic Copper	Lead	Tin Straits	Antimony	Aluminum 98-99	Zinc St. Louis
15.49	15.90	7.37	43.12	7.44	26.07	6.69

Comings and Goings of Foundrymen

FREDERICK JOHN COOK Rudge Littley Ltd., founders, Birmingham and West Bromwich, England, has been elected president of the Staffordshire Iron and Steel institute. He is well known in the United States, having represented the Institution of British Foundrymen at the annual meeting of the American Foundrymen's association held in Rochester, N. Y., in the spring of 1922. Mr. Cook was for 2 years president of the Institution of British Foundrymen. He also held the chairmanship for 3 years of the Midland Iron Founders' association, and for 3 years was secretary of the Malleable Iron Founders' association. After holding for 25 years the position of foundry manager to Belliss & Morcom, engineers, of Birmingham, Mr. Cook left the company seven years ago to become the head of the Rudge Littley firm.

Dr. Richard B. Moore, chief chemist of the bureau of mines at Washington, has resigned to enter a firm of consulting chemists and metallurgists in New York. He is succeeded by Dr. Samuel C. Lind, superintendent of the bureau's rare and precious metal experiment station at Reno, Nev.

Algernon L. Curtis, consulting expert in foundry sands and refractories, Chatteris, England, has been awarded a grant of £150 ($700) by the British Iron and Steel institute from the Andrew Carnegie research scholarship fund to carry out a research on steel molding sands and their behavior under high temperatures. Mr. Curtis was educated at Lincoln technical school, England, and the University of Pennsylvania.

Arthur L. Humphrey, president of the Westinghouse Airbrake Co., Wilmerding, Pa., and director of the United States chamber of commerce, was unanimously elected president of the Pittsburgh chamber of commerce recently. In addition to being president of the Westinghouse Airbrake Co., Mr. Humphrey has the following business connections: President of the Union Switch & Signals Co.; director of the Carbon Steel Co.; president and director Fallston Fire Clay Co.; president and director Keystone Clay Products Co.; chairman of the board of the Locomotive Stoker Co.; director and chairman executive committee Massey Concrete Products Corp. of Chicago; president and director Safety Car Devices Co., St. Louis; director and chairman Westinghouse Union Battery Co.; director of the Western National Bank of Pittsburgh; chairman of the board and director First National bank of Swissvale.

Detroit Founders Elect Officers for the Year

Presentation of a pair of platinum cuff links to Fred Erb, retiring president was the occasion for an enthusiastic demonstration by members of the Detroit Foundrymen's association at the twentieth annual banquet meeting held in the Michigan club, Detroit, Thursday, May 24. Mr. Erb has served three successive terms as president and is freely accorded the major part of the credit due for bringing the association up to its present standard of efficiency. Addressing the meeting he outlined briefly some of the activities of the association during preceding years and urged still further efforts in the future. Touching on the need for research work and the opportunities for intelligent young men in the foundry industry he intimated that Michigan university was ready to cooperate fully along any line suggested by the association. Addresses were delivered by S. W. Utley, Detroit Steel Castings Co., Pat Dwyer, engineering editor THE FOUNDRY, Cleveland and T. F. L. Henderson, La Salle Extension university, Chicago.

The following members were elected to office for the coming year: President, K. C. Babo, Dodge Bros.; vice president, Robert Crawford, Atlas Foundry Co.; secretary, D. R. Hay, Sanford Riley Stoker Co.; treasurer, Fred A. Cowen, Osborn Mfg. Co.; members of executive board, E. S. Van Dalson, Dodge Bros.; Fred Erb, Packard Motor Car Co.; Ed. I. Chase, Cadillac Motor Car Co.; E. W. Pike, Detroit Steel Castings Co.; H. M. Lane, H. M Lane Co.

Establish Western Plant

B. F. Sturtevant Co., Hyde Park, Boston, has purchased the plant of the Wisconsin Engine Co., Corliss, Wis. The new establishment which has been devoted to the manufacture of Corliss engines covers nearly 10 acres and has 150,000 square feet of floor space. A full manufacturing and engineering staff will be maintained at the Wisconsin plant under direction of Harry W. Page as general manager.

The Sturtevant company manufactures blowers, fans, dust exhausting systems and air conditioning equipment.

Hold Annual Election

At the regular monthly meeting of the Pittsburgh Foundrymen's association held at the General Forbes hotel, Monday, May 28 at 6:30 p. m., Jesse L. Jones, chief chemist in charge of physical and chemical departments of the Westinghouse Electric & Mfg. Co., delivered an address on "Research Work As Applied to the Foundry." At this meeting the following officers were elected for the ensuing year: President, John W. Guay, Fort Pitt Steel Casting Co., McKeesport, Pa., to succeed Samuel B. Guthbert; vice president, Ralph W. Jones, Union Switch & Signal Co.; Swissvale, Pa., to succeed Mr. Guay; secretary-treasurer, William J. Brant, Bessemer building, Pittsburgh, re-elected.

The following new executive committee was appointed: Samuel B. Cuthbert, Carnegie Steel Co., Braddock, Pa.; L. B. Snow, Hickman-Williams Co., Oliver building, Pittsburgh; Gustav A. Bauman, Jones & Laughlin Steel Corp., Pittsburgh; B. F. Mercer, Union Steel Casting Co., Pittsburgh; and L. V. Stevens, Locomotive Stoker Co., Pittsburgh.

Steel Group Meets

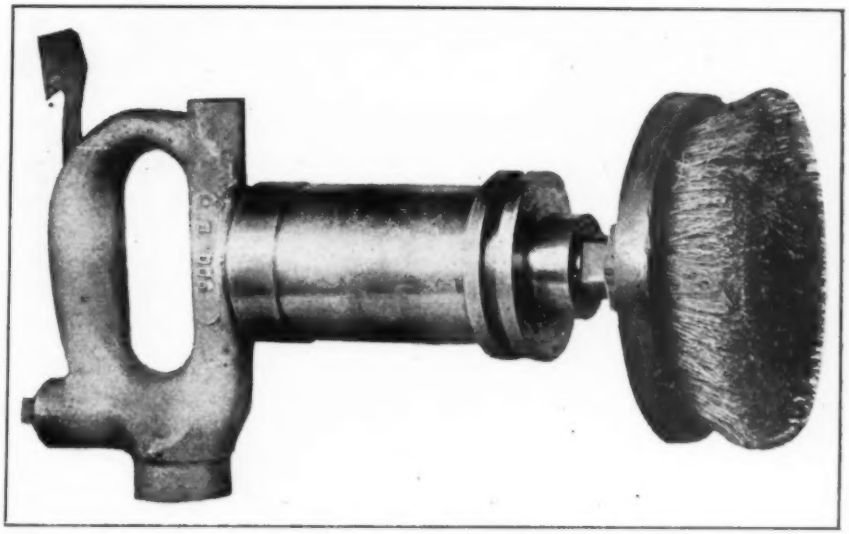
The Electric Steel Founders' Research group held a regular meeting of executives of the five electric steel foundries conducting co-operative research work at Wernersville, Pa., on May 14 to 17. Those in attendance were: W. J. Nugent, vice president Electric Steel Co., Chicago; C. S. Koch, president, and H. J. Koch, secretary, Fort Pitt Steel Casting Co., McKeesport, Pa.; W. H. Worrilow, president, T. S. Quinn, treasurer, and K. V. Wheeler, general manager, Lebanon Steel Foundry, Lebanon, Pa.; R. F. Flinterman, president, and H. A. Neel, manager, Michigan Steel Casting Co., Detroit; C. R. Messinger, vice president, R. J. Doty, vice president, and B. Fleeger, treasurer, Sivyer Steel Casting Co., Milwaukee; and R. A. Bull, research director of the group.

The various phases of the research work being done by the members of the group, to improve the quality of steel

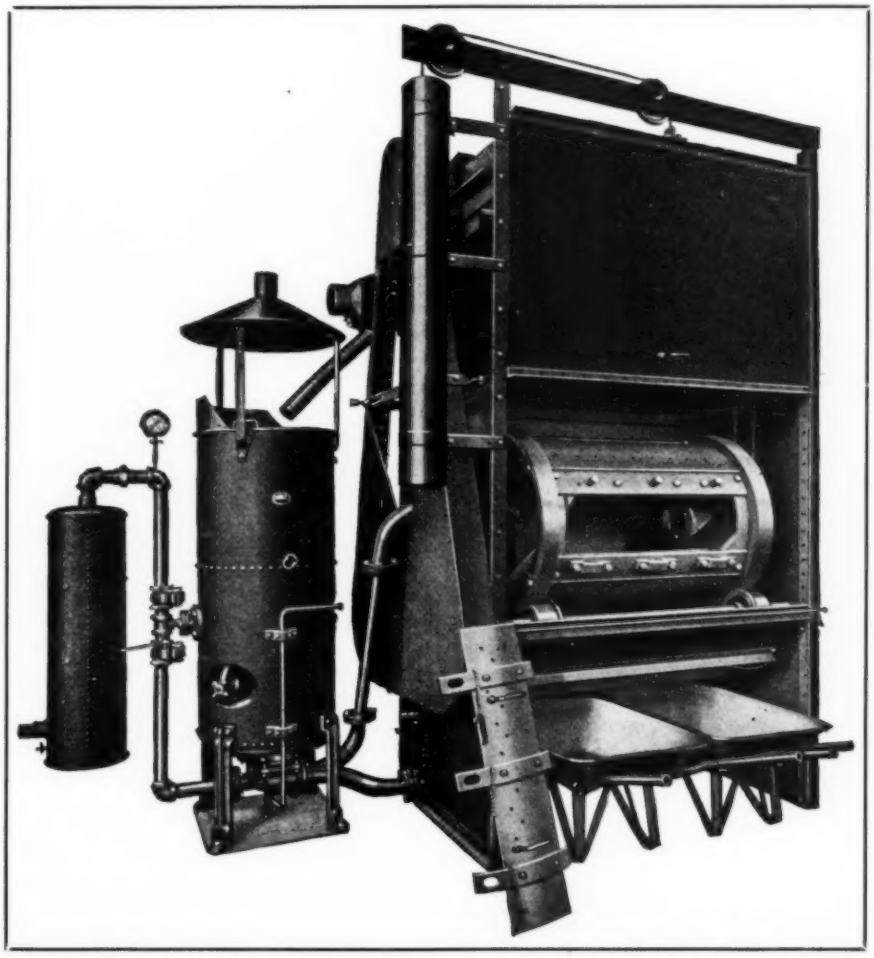
castings and increase efficiency in methods, were discussed in detail. Formal reports giving the status of the present research investigations were read on such subjects as facing sand mixtures, core sand mixtures, electric furnace practice, heat treatment of steel castings, production control, porosity in castings, etc.

Self Contained Barrel

Recent improvements in design and construction are incorporated in the piece of sandblasting apparatus shown in the acompanying illustration and made from the design of H. F. Hoevel by the J. W. Paxson Co., Philadelphia. The direct pressure system is employed which, it is stated, effects thorough and efficient cleaning at minimum cost and in a short time. The air carries the sand to nozzles through pipes made of steel and hard iron, heavily reinforced at all curves to prevent wear. The dust separator removes dust from the sand thus insuring that only clean sand will be re-used. An automatic filling valve in the sandblast tank opens immediately when the compressed air is shut off and allows the tank, to re-fill in little more than one minute. It closes automatically when the compressed air is turned on. The sand regulating valve permits an easy regulation of the abrasive without getting clogged. The dust is removed by an exhaust fan. Steel tires are shrunk onto heavy cast iron heads. The nozzles point into the barrel through a small hole in the end walls and in that manner the barrel is entirely free and unobstructed on the inside. Slanting end walls force the charge to roll sideways besides the turning effected by the rotation.



PNEUMATIC BRUSH OPERATES AT A SPEED OF 5000 REVOLUTIONS PER MINUTE



SHOWING MACHINE IN POSITION TO DUMP INTO WAITING WHEELBARROWS

Rotary Pneumatic Brush

Needs of foundrymen and others requiring a portable device for cleaning flat surfaces are served by a pneumatic rotary brush recently designed by the J. W. Paxson Co., Philadelphia. In addition to cleaning castings it is claimed that it is equally efficacious in cleaning steel and iron sheets, wood, stone, cement surfaces or in fact any large expanse of surface which cannot conveniently be taken to a fixed brush. The brush, made of No. 33 crimped steel wire in a twisted base inserted in a fiber block is operated by a motor constructed on the turbine principle claimed to be specially adapted to devices of this character on account of its lightness, strength and durability at a pressure of 50 pounds the motor develops a speed of 5000 revolutions per minute.

Warm Blast Conserves Cupola Heat

(*Concluded from Page* 509)

gases, composed of nitrogen and carbon dioxide, flow through the regulating valve *F* into the chimney *G*. By changing over the valve *A*, the blast may be directed into either heater alternately, thus providing a constantly heated chamber through which the blast enters the cupola. The center part of the apparatus, constituting the furnace stack proper, is in the form of an ordinary cupola shell without the windbox.

A saving of 35 per cent in coke consumption is claimed for some installations as well as a reduction of sulphur in the iron.

Equipment Sales Are Spotted

Varied Demand Characterizes the Market for Foundry Machinery and Supplies—Interest Shown in Heavy Molding Machinery—Foreign Inquiries Improve Despite Exchange Differences

WHILE sales of cupolas and other melting equipment are light, cranes and conveying machinery attracts varied interest, and light molding machines are slightly less active than previously, the movement of sand conditioning machinery is strong and a growing demand is noted for heavier type molding machines. Foreign inquiry for American made molding machines is increasing, despite the exchange relation. The Forest City Foundry Co., Cleveland, has purchased a cupola from the W. W. Sly Mfg. Co., Cleveland, and an air compressor from the Ingersoll-Rand Co., New York, for its new foundry under construction. Some molding machines still are needed. J. B. Clow & Sons, New Comerstown, O., is installing a cupola and ten 2-ton charging cars purchased from the Whiting Corp., Harvey, Ill. The Atlantic Steel Castings Co., Chester, Pa., is installing a continuous sand mixer capable of handling 25 tons an hour. This equipment was built by the Standard Sand & Machine Co., Cleveland. The latter firm has contracted with the Lakey Foundry & Machine Co., Muskegon, Mich., to provide a batch mixer designed to deliver 8 tons an hour. Pierce, Butler & Pierce, 411 West Forty-second street, New York, which recently took over the plant of the Federal Radiator Co., Zanesville, O., plans to increase the capacity of the foundry from less than 25 tons a day to over 100 tons per day. The Lawler Ironworks, Inc., Buffalo, has installed a 3-ton electric crane made by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. The Standard Sanitary Mfg. Co., Louisville, Ky., has purchased a grinding mill from the Hardinge Co., New York, to be used in grinding enamel grit. Ruthning Works, Ltd., iron and brass founders, Wooloongabba, Australia, is interested in the installation of an electric furnace for baking vitreous enamels. The Tennent Steel Castings Co., Tacoma, Wash., has purchased sand blast machinery from the Pangborn Corp., Hagerstown, Md.

Slight Pause in Eastern Buying

WHILE considerable inquiry is pending in this district, buying of foundry equipment during the past two weeks has slowed up. Foundry operations are being maintained at a good rate and considerable casting business is in sight; nevertheless, foundrymen manifest a tendency to hold off on equipment. Prices on foundry equipment as a whole are unchanged, although an advance in several lines in the near future appears likely. Only recently, several manufacturers of motors have advanced quotations on an average of five to 10 per cent and increasing costs of raw material and labor may also be expected to have a stimulating influence. New projects are not appearing in the number of a month or so ago. The Essex Brass Foundry, Boston, has recently acquired property for a new plant, the Richmond Radiator Co., Uniontown, Pa., is building a new shop and the Singer Mfg. Co., Elizabethport, N. J., contemplates a new foundry addition. Nevertheless, new construction at the moment is light. The Thatcher Furnace Co., Newark, N. J., has been a recent buyer of equipment, including a number of ladles which went to the Whiting Corp., Harvey, Ill. The American Brake Shoe Co. reported recently as in the market for equipment for a new plant at Portsmouth, Pa., has closed on cupolas, charging cars, dust arresters, ladles and other items to the Whiting Co. The Irvington Smelting & Refining Co., Irvington, N. J., has closed on a 5-ton electric crane, 20-foot span, to the same concern. The Palmyra Foundry Co., Palmyra, N. J., is erecting an addtioin to its iron foundry and at present is figuring on some miscellaneous equipment. The Norfolk & Western railroad is inquiring for two jar molding machines. The American Radiator Co. has closed on a 20-ton locomotive crane to the Industrial Works, Bay City, Mich. The American Malleables Co., Lancaster, N. Y., Osborn Machine Co., Dubois, Pa., Bethlehem Steel Co., Bethlehem, Pa. and the Lorain Steel Co., Johnstown, Pa. recently have purchased sand blast machinery from the Pangborn Corp., Hagerstown, Md.

Dullness Passing in Pittsburgh Territory

WHAT IS regarded in the Pittsburgh district as the aftermath of the American Foundrymen's association exposition in Cleveland, has resulted in a large number of orders for foundry equipment being placed. The complexion of the market has changed during the past week and the slump of two or three weeks ago has proved but temporary. Not only are the inquiries more unmerous, but the buying rate is heavy and foundry operators, notwithstanding labor shortages and other handicaps indicate that they expect good business to prevail throughout the third quarter and into the fourth quarter of the year. Two or three inquiries are out for sand-mixing, sand-conveying and other sand equipment. One or two sellers report the disposal of equipment in this line within the past few weeks. The movement of small supplies is heavy, particularly items such as flasks, wheelbarows, riddles, etc. The main improvement, however, is seen in connection with molding machines, the Herman Pneumatic Machine Co., Pittsburgh, reporting that it almost is impossible to catch up on inquiries. Orders for from one to three types machines during the past week have been particularly numerous and a fair number are about ready to close during the past week. Recent orders include the following: Three large machines from the Harbison-Walker Refractories Co.; two from the Keystone Iron & Steel Works, Los Angeles, Cal.; several from the Lloyd-Burnham Corp., Lancaster, Pa.; and one each from the following—the American Radiator Co., Buffalo; the Ohio Steel Foundry Co., Lima, O.; the Hunt-Spiller Mfg. Corp., Boston; American Cast Iron Pipe & Foundry Co., Birmingham, Ala.; National Brake & Electric Co., Milwaukee; American Woodworking Machinery Co., Rochester, N. Y.; the Joseph Reid Gas Engine Co., Oil City, Pa.; and the Brighton Electric Steel Casting Co., Beaver Falls, Pa. The Lloyd-Burnham Corp., Lancaster, Pa., too has been active in the purchase of other supplies and equipment. The Jamestown Malleable Furnace Co., Buffalo, may possibly purchase equipment at an early date. The American Brake Shoe & Foundry Co. has purchased sand blast machinery for its Portsmouth, Co. foundry from the Pangborn Corp., Hagerstown, Md.

Decrease Seen in Chicago Demand

BUYING of foundry equipment has decreased sharply from the crest of the spring season and while there is much inquiry for the heavier equipment showing the need for additions and replacements, they are slow to close. Cupolas, tumbling barrels and large ladles, cranes and similar equipment has been bought heavily for several months. Small ladles, trucks and this class of equipment is moving well. Sand conditioning ma-

chinery continues to be bought as the need for proper preparation of sand is being more widley recognized by melters. Recent purchases of sand blast machinery from the Pangborn Corp., Hagerstown, Md., include the Kewanee Boiler Co., Kewanee, Ill., Mattison Machine Works, Rockford, Ill., and the International Harvester Co., Chicago.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Erection of a plant has been started by the Richmond Radiator Co., Uniontown, Pa.

The plant of the Oxford Foundry & Machinery Co., Oxford, N. J., recently was damaged by fire.

The plant of the New Haven Foundry Co., New Haven, Mich., recently was damaged by fire.

The H. B. Smith Co., Westfield, Mass., will start work soon on the erection of a foundry building, one story.

The Saco Lowell Shops, Walker street, Boston, has awarded a contract for the erection of a plant building.

The Co-Operative Foundry Co., Rochester, N. Y., plans improvements and additions to its plant.

The Nims Pump Co., Stockton, Cal., recently organized with $150,000 capital stock, plans to erect a plant building.

Construction of a foundry building is under consideration by the Singer Mfg. Co., Elizabethport, N. J.

The Essex Brass Foundry, Boston, is reported planning the erection of a foundry on a site which it recently acquired.

Capitalized at $8000 the Pacific Foundry Co., Tacoma, Wash., recently was incorporated by John Borges, W. H. Allard and Samuel Fick.

The Tulsa Bearings Co., Tulsa, Okla., recently was incorporated to engage in the manufacture of bearings for automotive service. G. B. Davidson is president of the company.

Capitalized at $11,000 the Non-Ferrous Metal Co., Dayton, O., recently was incorporated by B. R. Shaman, R. E. Mars, Samuel Froehle, J. C. Kusworn and Irving Braunstein.

The Fillmore Avenue Foundry & Iron Works, Inc., 153 Fillmore avenue, Buffalo, plans the erection of a 1-story foundry addition.

The Foster Foundry Co., Knoxville, Tenn., has been incorporated with a capital stock of $2000 by Land Foster, C. L. Nickle, Wayne Parkey and James Webster Jr.

The W. A. Jones Foundry & Machine Co., Chicago, plans the erection of a 1-story shop building, to be built at an estimated cost of $49,000.

Work has been started by the Chicago Bearing Metal Co., 2234 West Forty-third street, Chicago, on the erection of a 1-story plant addition, 35 x 100 feet, to be built at an estimated cost of $20,000.

Capitalized at $10,000 the Ornamental Brass & Fixture Co., 728-730 West Randolph street, Chicago, recently was incorporated by Frank Goldberg, Mitchell Edelson and Rose Benjamin. The company is represented by Edelson & Tannebaum, 111 West Washington street.

Capitalized at $1500 the Atlas Bronze Mfg. Co., 412 Orleans avenue, Chicago, recently was incorporated by Louis E. Price, James L. Price and Charles C. Brecht. The company is represented by Emanuel M. Schwartz, 1001 Conway building.

The Illinois Valve & Mfg. Co., 4247 East Ravenwood avenue, Chicago, has been incorporated to manufacture and deal in machinery and machine products, with a capital stock of $15,000. The company is represented by Edgar H. Schroeder, Marquette building.

The Chicago Die Casting Mfg. Co., 508 Sangamon street, Chicago, has been incorporated with $30,000 capital stock by Albert Lorr, Paul E. Koch, Carl F. Beuster and others. The company is represented by Murphy, Altenburg & Power, 7 West Madison street.

Structural steel has arrived and is being set in place by the contractors erecting the new addition at the Anderson Foundry & Machine Works, Anderson, Ind. The building is to be 100 feet long and will connect with the present machine room.

The Frank Foundry & Machine Co., 1735 West Second street, Davenport, Iowa, plans the erection of a 1-story plant building at Moline, Ill., 75 x 100 feet, to be built at an estimated cost of $15,000. H. J. Frank is president of the company.

A. M. Jones of the A. M. Jones & Co. has purchased the plant of the West Allis Foundry Co., West Allis, Milwaukee. He will continue the manufacture of gray iron and semisteel castings and the organization operating the foundry will not be changed.

The New Jersey Valve & Fitting Co., Inc., Second avenue and Susquehanna railroad, Hawthorne, N. J., recently was incorporated to engage in the manufacture of copper, brass and aluminum valves, fittings and specialties. James C. Smith is president of the company and James A. Duffy, secretary-treasurer.

The McQuay Norris Mfg. Co., care of the Corporation Trust Co. of America, Wilmington, Del., recently was incorporated with a capital stock of $10,000,000, to engage in the manufacture of piston pins. The company now has three fully equipped plants. John F. Green is president of the company.

Capitalized at $12,000 the D. G. Foundry Co., 279-281 East Twelfth street, Chicago, has been incorporated by George Gawonis, Richard Gawonis, Dennis K. Lindhout, Benny Gatch, J. A. Dooley, Mike Survil and Pete Bekeza. The company is represented by D. K. Lindhout.

G. M. Johnson, formerly of the Portsmouth navy yard, Portsmouth, N. H., and more recently connected with the Portsmouth Foundry, has purchased the plant operated by the Rochester Foundry & Machine Co., Rochester, N. H. He plans to operate the plant under the name of the Johnson Foundry.

The Electric Steel Co., Thirty-first and Wood streets, Chicago, has changed its name to the Nugent Steel Castings Co. No change in management or ownership has been made. Charles Piez is president; W. J. Nugent, vice president and general manager; P. L. Coonley, treasurer, and C. A. MacDonald, secretary.

The American Ringless Piston Corp., Lancaster, Pa., has been incorporated with a capital stock of $500,000 and will engage in the manufacture of ringless pistons. It now is completing plans for the erection of a plant near Lancaster. Officers of the company are: President, E. F. Herr; vice president, J. S. Brubaker; secretary, C. A. Potts, and treasurer, N. F. Herr.

The Wanner Malleable Castings Co. recently formed to acquire the assets of the Wanner Malleable Iron Co. of Indiana, has purchased a foundry at South Beloit, Ill., which is fully equipped for operation. The company has another plant at Hammond, Ind. Present capacity is about 130 tons a day. H. J. Wanner is chairman of the board and H. C. Wanner is president.

Youngstown Foundry & Machine Co., Youngstown, O., has acquired by purchase the Poland avenue plant of the Mahoning Foundry Co. and has started operating it. Acquisition of this plant gives the company three plants in Youngstown. Two are devoted to general iron foundry and machine shop work while one is utilized for the making of chilled and sand rolls. The company recently bought 12 acres near Girard, O., where it will erect a modern plant devoted exclusively to making rolls.

New Trade Publications

BUILDING PRODUCTS—An illustrated folder has been published by the Truscon Steel Co., Youngstown, O., in which building products produced by the company are described and their use illustrated. These include metal lath, steel sash, concrete reinforcement, etc. The illustrations are of buildings in which these products have been used, and include office buildings, factory structures and general construction.

FUEL OIL BURNERS—Tate-Jones & Co., Inc., Pittsburgh, has published a 4-page illustrated folder in which fuel oil burners are described and illustrated. The illustrations are of burners designed for standard furnace practice. Five types are each being for a different installation.

LIFTING MAGNETS—The Cutler-Hammer Mfg. Co., Milwaukee, has published an 18-page illustrated booklet in which lifting magnets are described and illustrated. The features of these magnets include a heavy outer pole shoe of massive flange construction and protected pockets for bolt head in both the inner and outer pole shoes. The magnets are made in several sizes. Special mention is made in the booklet of the method of control and the

magnetic controller and master switch furnished with the magnets. The numerous illustrations give evidence of the many applications of these magnets.

CENTRIFUGAL PUMPS—A 16-page illustrated booklet has been published by the Pennsylvania Pump & Compressor Co., Easton, Pa., in which double suction, single stage centrifugal pumps are described and illustrated. These pumps are built in sizes to handle capacities up to 20,000 gallons per minute and for heads up to 250 feet. They may be had for single or series operation, either direct connected to a motor or belt driven by gas engine, steam engine or steam turbine, to meet the power conditions of the individual installations. A complete description is given.

PANEL BOARDS—A folder has been published by the Sprague Electric Works of the General Electric Co., New York, in which safety type panel boards and cabinets are described and illustrated. These are designed for places where the bus-bars and other live parts must be covered, yet the fuse plugs left accessible.

GAS PRODUCER—The Wellman-Seaver Morgan Co., Cleveland, has published a 16-page illustrated booklet in which a new type gas producer is described and illustrated. According to the folder this producer embodies many improvements. It is self-contained; is entirely automatic from coal feed to ash disposal; has simplified driving action; the ash pan rotates intermittently and a combined steam-jet and turbo-blower is provided. Some of the results obtained with this producer, according to the booklet, are increased mechanical efficiency; greatly increased gas-making capacity; uniform quality of gas; no clinkering of the brick lining; hand poking eliminated and reduced maintenance.

PORTABLE TIMING DEVICE—The General Electric Co., Schenectady, N. Y., has published a bulletin in which a portable timing device is described and illustrated. This device consists of an encased clock to be used with a standardized clock as a means of secondary timing, to supplant the stop watch. It is applicable to graphic instruments, measurements of angular velocities and for indicating a definite time-interval ranging from one second to any whole number of minutes. The instrument illustrated in the bulletin consists of a clock, relays, and a gear train which by adjustment can be set to meet different demands of service. Power is supplied from a local flashlight type of battery.

STEAM TURBINES—The use of steam turbines for driving heavy machinery exposed to carbon dust and grit is advocated in a pamphlet recently issued by the De Laval Steam Turbine Co., Trenton, N. J. Two steam turbines recently were installed in the by-product coke oven plant of the New England Fuel & Transportation Co., Everett, Mass., for driving direct current generators and for operating swing hammer coal crushers. These turbines run at 5000 revolutions per minute which is reduced to 750 revolutions per minute for the crushers by a double helical speed reducing gear. The use of turbines for driving the crushers has not only effected considerable savings in plant investment, according to the pamphlet, but also makes it possible to keep the crushers in operation when the main power units are shut down. The lubricating oil for the entire plant is protected by centrifugal purifiers. Originally the oiling system of the main turbo generator unit and engines was connected to a gravity oil filtering system, but when the geared turbines for operating the crushers were purchased, a centrifugal purifier was installed and temporarily connected to the old oiling system. It removed so much dirt and water which had passed through the gravel filter that the management decided to keep it permanently connected to the main oiling system and a second centrifugal purifier was ordered for the crusher turbines.

BELT SANDER AND GRINDER—An illustrated folder has been published by the Porter-Cable Machine Co., Syracuse, N. Y., in which a portable direct motor-driven belt sander and grinder is described and illustrated. This machine is adjustable for use in a vertical or horizontal position. It is compact and built like a machine tool in design. A special feature is the arrangement for setting the grinding bed at any position from horizontal to vertical which makes it adaptable for different classes of work. The table can be tilted by means of a hand wheel, 45 degrees down and 15 degrees up. Another small bulletin has been published by the company which calls attention to its various other tools. These include disk grinders, oscillating spindle sanders, disk grinder and sander, and band-saws.

BAR BENDING MACHINES—McKenna Co., Cleveland, has published an illustrated bulletin in which bar bending machines are described and illustrated. The machine is built in five different types. All machines will bend rods up to 1¼ inches. Each type of machine is described in some detail. In addition a steel shear is described and illustrated.

CRANES—An 88-page illustrated catalog has been published by the Whiting Corp., Harvey, Ill., in which cranes and allied equipment are described and illustrated. The equipment includes electric-traveling, bucket handling, gantry, transfer, handpower, jib, pillar and bracket cranes, as well as lifting attachments, railway specialties and clearance tables.

GEAR SHAPER—A 40-page illustrated booklet has been published by the Fellows Gear Shaper Co., Springfield, Vt., in which a new type of gear shaper is described and illustrated. This shaper has been designed to cut one gear at a time. It is full ball bearing equipped with high-speed bearings automatically lubricated. It is simple in construction and easy to operate. According to the bulletin, the shaper has met with great success in the finishing of automobile transmission gears and now is used extensively for this work.

WASH FOUNTAINS—An illustrated booklet has been published by the Bradley Washfountain Co., Milwaukee, in which wash fountains are described and illustrated. These are designed for use in factories, hotels, schools and buildings where lavatories are required. The fountains are circular in shape, have one water inlet and one large open drain. They are made in two sizes, one size accommodating 6 persons and the other 10. Numerous illustrations of actual installations are given in the booklet.

GRAPHIC INSTRUMENTS—A 4-page illustrated folder has been published by the Easterline-Angus Co., Indianapolis, Ind., in which some of the uses of graphic instruments are pointed out. These include their use in saw mills; in checking the operation of brakes; in recording water levels; testing pipe, etc. Another 4-page folder has been published by the company in which instruments for recording condenser leakage and indicating concentration of boiler water are described and illustrated. The instruments are described in brief detail.

PORTABLE TOOLS—A 16-page illustrated bulletin has been published by the Hisey-Wolf Machine Co., Cincinnati, in which portable electric drills and reamers are described and illustrated. Construction and characteristics of the tools are outlined and specifications given. Drilling stands, attachments and accessories also are described.

SCRAP METAL PRESSES — Logemann Bros. Co., Milwaukee, has published a 4-page illustrated bulletin in which baling and scrap metal presses are described and illustrated. These presses are made in 10 distinct models. A complete unit consists of press, triplex high pressure pump, control accumulator, operating valve and tank for fluid. The presses are of rugged construction; box liner plates are of high carbon steel; rams are steel forgings. On the larger presses forged cylinders also are used. Users of metal presses include steel, aluminum and copper rolling mills, railroads, automobile builders, manufacturers of cooking utensils and many similar and allied industries.

OVENS—The F. A. Coleman Co., Cleveland, has published a 44-page illustrated booklet in which foundry ovens, both for core baking and mold drying, are described and illustrated. The company manufactures ovens designed for use with any fuel, or electrically heated. According to the booklet three types of ovens are in use today: The rolling drawer oven; the rack oven and the car oven. Each of these types is described in detail and are fully illustrated. The booklet also calls attention to the miscellaneous and special types of ovens which the company manufactures. A partial list of users of Coleman ovens is given in the back of the booklet. In addition to ovens the company also manufactures complete core room equipment, including core racks, core cars, mold cars, transfer cars, etc.

PLATFORM TRUCK—A 4-page illustrated folder has been published by the Automatic Transportation Co., Buffalo, in which an elevating platform truck with a capacity of 6000 pounds is described and illustrated. Another 4-page illustrated folder has also been issued by the company in which a 3-wheel industrial tractor is described and illustrated.

TIER LIFTING TRUCK—The Automatic Transportation Co., Buffalo, has published a 20-page illustrated booklet in which a tier lifting truck is described and illustrated. This truck is essentially an electric elevating platform truck with a lifting or tiering device. It has a capacity of 4000 pounds and may be furnished in various weights. It raises a load in cantilever fashion on two uprights and may be started and stopped at any height. The lift is by means of a single oversize screw revolving in a large oversize bronze nut, carried in a trunnion and provided with an oil magazine. Maximum loads of 4000 pounds are elevated 1 foot in 12 seconds. To eliminate accidents, the truck is equipped with an automatic cutout which operates when load reaches extreme high or low position.

PROTECTIVE APPAREL.—A 16-page illustrated folder is being circulated by the F. H. Wheeler Mfg. Co., Chicago, in which protective wearing apparel is described and illustrated. This includes leggings, asbestos mittens and gloves, aprons, helmets, etc.

METAL HOSE.—A 4-page circular has been published by the Pennsylvania Flexible Metallic Tubing Co., Philadelphia, in which all metal, heavy-duty hose and couplings for tank car unloading are described and illustrated. This hose is adapted to the unloading of tank cars. Couplings are extra heavy and especially designed to withstand the severe demands of tank car unloading service.

PORTABLE BANDSAW.—The Racine Tool & Machine Co., Racine, Wis., has published a 4-page illustrated folder in which a portable bandsaw is described and illustrated. This tool is of the duplex type, being adaptable to wood and metal cutting and is designed for use in pattern shops, tool rooms, trade schools, etc. Detailed specifications are given.

MALLEABLE CASTINGS.—A 36-page illustrated booklet has been issued by the Brown Instrument Co., Philadelphia, containing a treatise on the making of malleable castings. The data was collected by M. M. Watkins, research engineer for the Brown company, in some 40 of the most representative malleable plants in the country. The use of temperature control and recording equipments is pointed out. The back part of the booklet contains numerous letter testimonials from users of the Brown company's temperature control and recording equipment.